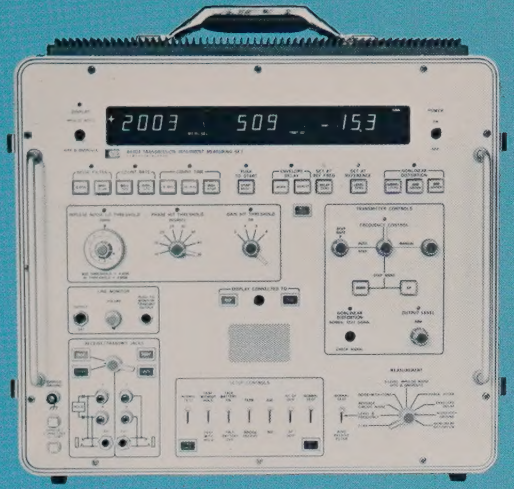
HEWLETT PACKARD

Model 4940A

Transmission Impairment Measuring Set



Operating Instructions

OPERATING INSTRUCTIONS

TRANSMISSION IMPAIRMENT MEASURING SET

Model 4940A
All Serial Numbers

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690 E. Middlefield Road, Drawer 7021, Mountain View, CA 94042 U.S.A.

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INTRODUCTION

This booklet contains quick reference instructions for operating the Hewlett-Packard Model 4940A Transmission Impairment Measuring Set (TIMS). For more detailed operating instructions and description of this test set, refer to the Operating Manual (HP Part No. 04940-90010). Complete maintenance information is provided in the Service Manual (HP Part No. 04940-90012), which can be obtained by returning the card enclosed in the Operating Manual.

GENERAL DESCRIPTION

TIMS measures all of the parameters necessary to characterize a voice channel for its ability to transmit data traffic. Measurements are selected by turning the MEASUREMENT switch to the desired position. Indicator dot lamps are automatically lit up above all switch groups requiring a selection for that particular measurement.

The test set can be used both as a transmitter and receiver to make either end-to-end or loop-around measurements. TIMS is compatible for making end-to-end measurements with most existing test sets. However, TIMS meets the requirements of improved measurement specifications for Nonlinear Distortion; 3-Level Impulse Noise, Hits and Dropouts; Noise-with-Tone and P/AR, which may make other test sets incompatible for these measurements.

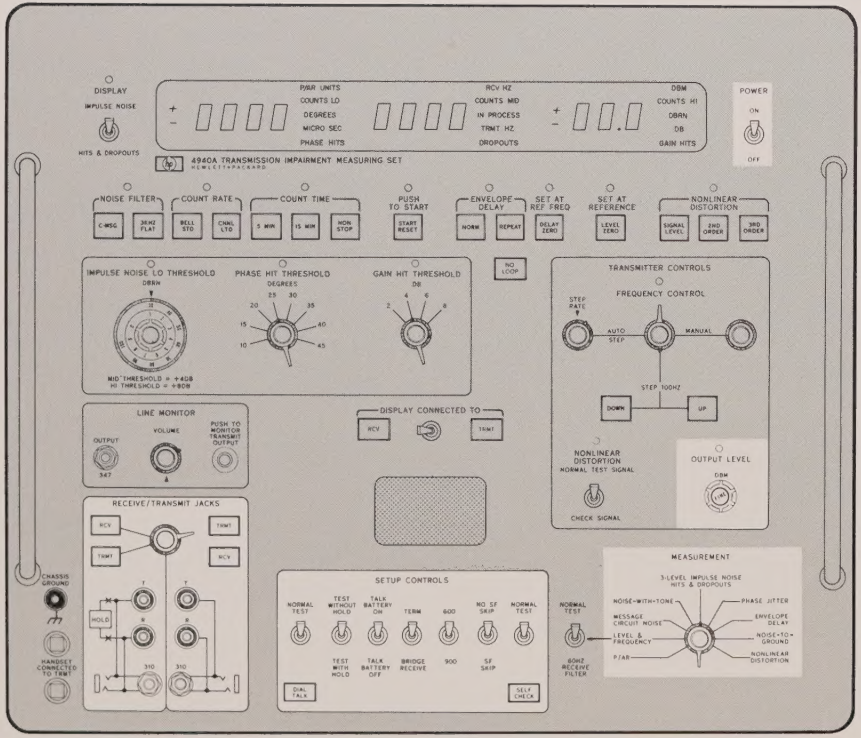
All measurements are displayed on digital readouts. Three separate readouts allow simultaneous display of up to three different parameters. The displays can be selected to show either transmitted or received information. Measurement unit annunciators beside each readout show the operator the measurement displayed. Ranging, decimal placement, and polarity are all completely automatic.

OPTIONS

TIMS is available with various factory options. Option 001 includes P/AR MEASUREMENT; Option 002 includes NONLINEAR DISTORTION MEASUREMENT; Option 003 includes both P/AR and NONLINEAR DISTORTION MEASUREMENTS. Options are also available for mounting in a 19" wide relay rack (Option 019); and for mounting in a 23" wide relay rack (Option 023).

IDENTIFICATION

Each unit is identified by a distinctive serial number and option number (if applicable) engraved on a plate on the bottom of the test set. Please refer to this identification when corresponding with Hewlett-Packard regarding servicing and operating matters.


DISPLAY
IMPULSE NOISE
HITS & DROPOUTS
PAIR UNITS
COUNTS LO
DEGREES
MICRO SEC
PHASE HITS
RCV HZ
COUNTS MID
IN PROCESS
TRMT HZ
DROPOUTS
DBM
COUNTS HI
DBRN
DB
GAIN HITS
POWER
ON
OFF
4940A TRANSMISSION IMPAIRMENT MEASURING SET
HEWLETT-PACKARD
NOISE FILTER
C-MSG
3KHZ FLAT
COUNT RATE
RCLL STO
CNNL LTO
COUNT TIME
5 MIN
15 MIN
NON STOP
PUSH TO START
START RESET
ENVELOPE DELAY
NORM
REPEAT
SET AT REF FREQ
DELAY ZERO
SET AT REFERENCE
LEVEL ZERO
NONLINEAR DISTORTION
SIGNAL LEVEL
2ND ORDER
3RD ORDER
IMPULSE NOISE LO THRESHOLD
DBRN
MID THRESHOLD = +4DB
HI THRESHOLD = +8DB
PHASE HIT THRESHOLD
DEGREES
GAIN HIT THRESHOLD
DB
NO LOOP
TRANSMITTER CONTROLS
FREQUENCY CONTROL
STEP RATE
AUTO STEP
MANUAL
STEP 100HZ
DOWN
UP
NONLINEAR DISTORTION
NORMAL TEST SIGNAL
CHECK SIGNAL
OUTPUT LEVEL
DBM
LINE MONITOR
OUTPUT
VOLUME
PUSH TO MONITOR TRANSMIT OUTPUT
347
DISPLAY CONNECTED TO
RCV
TRMT
RECEIVE/TRANSMIT JACKS
RCV
TRMT
TRMT
RCV
T
R
HOLD
310
310
CHASSIS GROUND
HANDSET CONNECTED TO TRMT
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
NORMAL TEST
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECEIVE
900
SF SKIP
DIAL TALK
SELF CHECK
MEASUREMENT
3-LEVEL IMPULSE NOISE HITS & DROPOUTS
NOISE-WITH-TONE
PHASE JITTER
MESSAGE CIRCUIT NOISE
ENVELOPE DELAY
LEVEL & FREQUENCY
NOISE-TO-GROUND
P/AR
NONLINEAR DISTORTION
NORMAL TEST
60HZ RECEIVE FILTER

SETUP AND TURN ON

1. Connect power cord to receptacle on top of test set and to 117 volts, 60Hz ac power line.

CAUTION

Do not place any object, such as manuals, clipboards, etc., on top of the test set. Restriction of air from the fan or cooling fins can cause overheating and damage to the test set.

2. Throw POWER switch to ON position to apply power to test set.
3. Throw SETUP CONTROLS key to BRIDGE RECEIVE if test set is to be bridged across receive line. Throw key to TERM if test set is to be used as termination on the receive line.
4. Throw SETUP CONTROLS key to 600 or 900 to match impedance of lines under test.
5. Throw SETUP CONTROLS key to SF SKIP if transmitting over a dial-up network and single frequency (SF) signaling units are on the network.
6. Throw far-right SETUP CONTROLS key to NORMAL TEST. Refer to SELF CHECK PROCEDURES (Section 13) if it is desired to run self check procedure on test set.

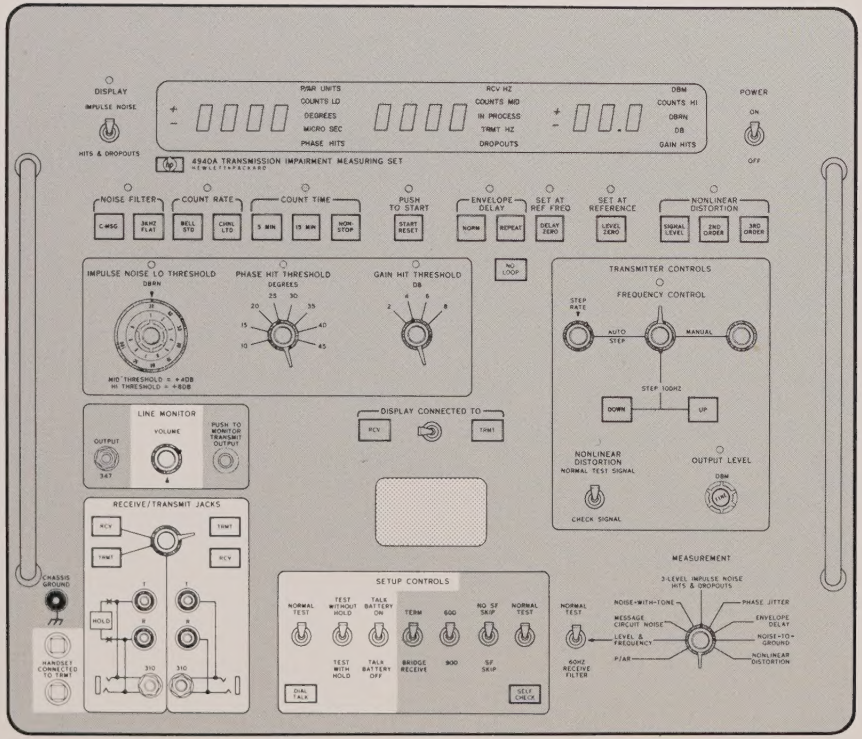
NOTE

The self check procedure should be performed periodically to verify performance of the test set. SELF CHECK is recommended before transporting the test set to a remote testing site; or whenever there is any doubt about transmission measurement results.

7. Rotate OUTPUT LEVEL control full counterclockwise.
8. Rotate RECEIVE/TRANSMIT JACKS switch to select whether left jack field is to be used for TRMT or RCV. Connect transmit and receive lines (if both are required) to the appropriate TRANSMIT/RECEIVE JACKS. Refer to DIAL, TALK, LISTEN, and HOLD PROCEDURES (Section 3) for proper hookup and control operation if dialing, talking, listening or holding are necessary on the lines under test.
9. Select desired MEASUREMENT mode and refer to appropriate measurement instructions section.

NOTE

The MEASUREMENT switch turns on indicator dot lamps over control groups that are active for that particular measurement. These lamps are a special aid to the selection of push-button switches. If an improper condition (i.e., all or no push-buttons depressed) exists in an active switch group, all indicator dot lamps and the display will go out, except the indicator dot lamp over the group that requires a selection.


DISPLAY
IMPULSE NOISE
HITS & DROPOUTS
P/AR UNITS
COUNTS LD
DEGREES
MICRO SEC
PHASE HITS
RCV HZ
COUNTS MID
IN PROCESS
TRMT HZ
DROPOUTS
DBM
COUNTS HI
DBRN
DB
GAIN HITS
POWER
ON
OFF
4940A TRANSMISSION IMPAIRMENT MEASURING SET
HEWLETT-PACKARD
NOISE FILTER
C-MSG
3KHZ FLAT
COUNT RATE
BELL STD
CHNL LTD
COUNT TIME
5 MIN
15 MIN
NON-STOP
PUSH TO START
START RESET
ENVELOPE DELAY
NORM
REPEAT
SET AT REF FREQ
DELAY ZERO
SET AT REFERENCE
LEVEL ZERO
NONLINEAR DISTORTION
SIGNAL LEVEL
2ND ORDER
3RD ORDER
IMPULSE NOISE LO THRESHOLD
DBRN
MID THRESHOLD = +40B
HI THRESHOLD = +80B
PHASE HIT THRESHOLD
DEGREES
GAIN HIT THRESHOLD
DB
NO LOOP
TRANSMITTER CONTROLS
FREQUENCY CONTROL
STEP RATE
AUTO STEP
MANUAL
STEP 100HZ
DOWN
UP
NONLINEAR DISTORTION
NORMAL TEST SIGNAL
CHECK SIGNAL
OUTPUT LEVEL
DBM
LINE MONITOR
OUTPUT
VOLUME
PUSH TO MONITOR TRANSMIT OUTPUT
DISPLAY CONNECTED TO
RCV
TRMT
RECEIVE/TRANSMIT JACKS
HOLD
310
CHASSIS GROUND
HANDSET CONNECTED TO TRMT
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
NORMAL TEST
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECEIVE
900
SF SKIP
DIAL TALK
SELF CHECK
MEASUREMENT
3-LEVEL IMPULSE NOISE HITS & DROPOUTS
NOISE+WITH+TONE
PHASE JITTER
MESSAGE CIRCUIT NOISE
ENVELOPE DELAY
LEVEL & FREQUENCY
NOISE+TO+GROUND
P/AR
NONLINEAR DISTORTION
NORMAL TEST
60HZ RECEIVE FILTER

DIAL, TALK, LISTEN, AND HOLD

1. Perform SETUP AND TURN ON PROCEDURES (Section 2) through Step 8.
2. Connect lineman's handset (butt-in) to HANDSET CONNECTED TO TRMT connector posts.
3. Refer to table below for proper hookup and control settings.

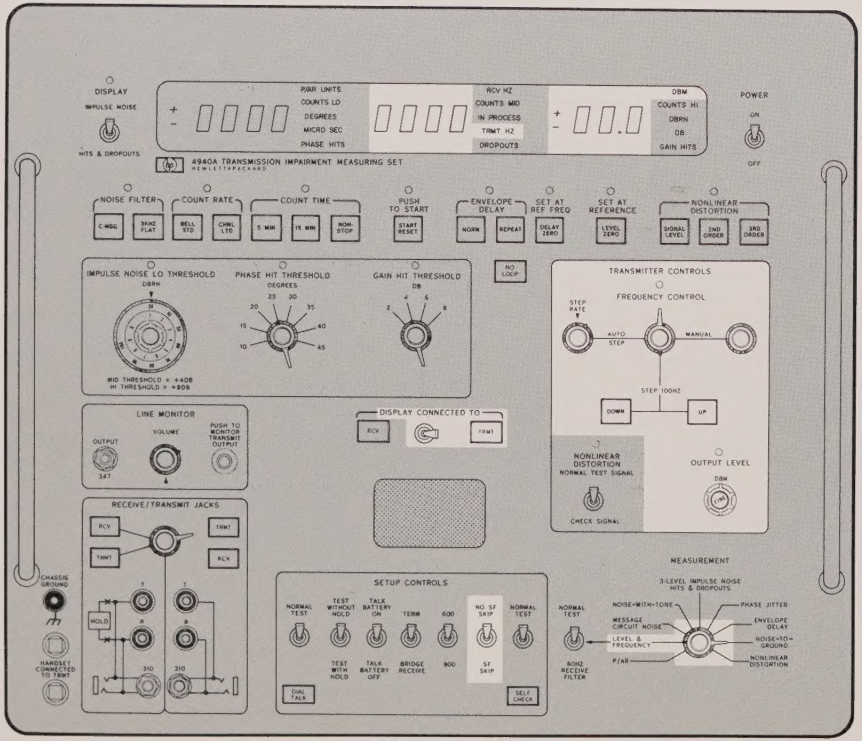
NOTE

When going to NORMAL TEST mode on 2-wire wet (DDD) line, make sure SETUP CONTROLS key is in TEST WITH HOLD position before switching to NORMAL TEST. Failure to do so will cause the dial-up connection to be lost.

4. To return to talk or listen mode after normal tests are in progress, throw SETUP CONTROLS key to DIAL/TALK. Rotate RECEIVE/TRANSMIT JACKS switch as indicated for 2-wire circuits.

HOOKUP AND SETUP CONTROL SETTINGS FOR DIALING, TALKING, LISTENING, HOLDING AND TESTING

MODE	CIRCUIT		
	2-Wire Wet (DDD)	2-Wire Dry (DAA)	4-Wire Dry
HOOKUP	Transmit line connected to left RECEIVE/TRANSMIT JACKS	Transmit line connected to right RECEIVE/TRANSMIT JACKS	Transmit line connected to either RECEIVE/TRANSMIT JACKS
DIAL	DIAL/TALK; TALK BATTERY OFF; TEST WITHOUT HOLD; LEFT JACK TO TRMT (Dial with butt-in)		
TALK	DIAL/TALK; TALK BATTERY OFF; TEST WITH HOLD; LEFT JACK TO TRMT (Talk through butt-in)	DIAL/TALK; TALK BATTERY ON; TEST WITHOUT HOLD; RIGHT JACK TO TRMT (Talk through butt-in)	DIAL/TALK; TALK BATTERY ON; TEST WITHOUT HOLD (Talk through butt-in)
LISTEN	DIAL/TALK; TALK BATTERY OFF; TEST WITH HOLD; LEFT JACK TO TRMT (Listen through butt-in)	DIAL/TALK; TALK BATTERY ON; TEST WITHOUT HOLD; RIGHT JACK TO TRMT (Listen through butt-in)	Adjust LINE MONITOR as required (Listen through LINE MONITOR speaker)
TEST	TALK BATTERY OFF; TEST WITH HOLD; NORMAL TEST (Throw TEST WITH HOLD key before throwing NORMAL TEST key); LEFT JACK TO RCV IF RCV TEST SET	TALK BATTERY ON; TEST WITHOUT HOLD; NORMAL TEST; RIGHT JACK TO RCV IF RCV TEST SET	TALK BATTERY ON; TEST WITHOUT HOLD; NORMAL TEST


DISPLAY
IMPULSE NOISE
HITS & DROPOUTS
P/AR UNITS
COUNTS LO
DEGREES
MICRO SEC
PHASE HITS
RCV HZ
COUNTS MID
IN PROCESS
TRMT HZ
DROPOUTS
DBM
COUNTS HI
DBRN
DB
GAIN HITS
POWER
ON
OFF
4940A TRANSMISSION IMPAIRMENT MEASURING SET
HEWLETT-PACKARD
NOISE FILTER
C-MSG
3KHZ FLAT
COUNT RATE
BELL STD
CHNL LTD
COUNT TIME
5 MIN
15 MIN
NON-STOP
PUSH TO START
START RESET
ENVELOPE DELAY
NORM
REPEAT
SET AT REF FREQ
DELAY ZERO
SET AT REFERENCE
LEVEL ZERO
NONLINEAR DISTORTION
SIGNAL LEVEL
2ND ORDER
3RD ORDER
IMPULSE NOISE LO THRESHOLD
DBRN
MID THRESHOLD = +40B
HI THRESHOLD = +80B
PHASE HIT THRESHOLD
DEGREES
GAIN HIT THRESHOLD
DB
NO LOOP
TRANSMITTER CONTROLS
FREQUENCY CONTROL
STEP RATE
AUTO STEP
MANUAL
STEP 100HZ
DOWN
UP
NONLINEAR DISTORTION
NORMAL TEST SIGNAL
CHECK SIGNAL
OUTPUT LEVEL
DBM
LINE MONITOR
OUTPUT
VOLUME
PUSH TO MONITOR TRANSMIT OUTPUT
DISPLAY CONNECTED TO
RCV
TRMT
RECEIVE/TRANSMIT JACKS
HOLD
310
CHASSIS GROUND
HANDSET CONNECTED TO TRMT
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
NORMAL TEST
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECEIVE
900
SF SKIP
DIAL TALK
SELF CHECK
MEASUREMENT
3-LEVEL IMPULSE NOISE HITS & DROPOUTS
NOISE-WITH-TONE
PHASE JITTER
MESSAGE CIRCUIT NOISE
ENVELOPE DELAY
LEVEL & FREQUENCY
NOISE-TO-GROUND
P/AR
NONLINEAR DISTORTION
NORMAL TEST
60HZ RECEIVE FILTER

LEVEL & FREQUENCY
TRANSMITTER

1. Rotate MEASUREMENT switch to LEVEL & FREQUENCY.
2. Throw DISPLAY CONNECTED TO key to TRMT.
3. Rotate FREQUENCY CONTROL switch to STEP 100 HZ. Set transmit frequency to 1004 Hz by pressing DOWN or UP push-buttons, while observing TRMT HZ on center display.
4. Adjust OUTPUT LEVEL control for "Data Level" while observing DBM output level on right display.

DATA LEVEL

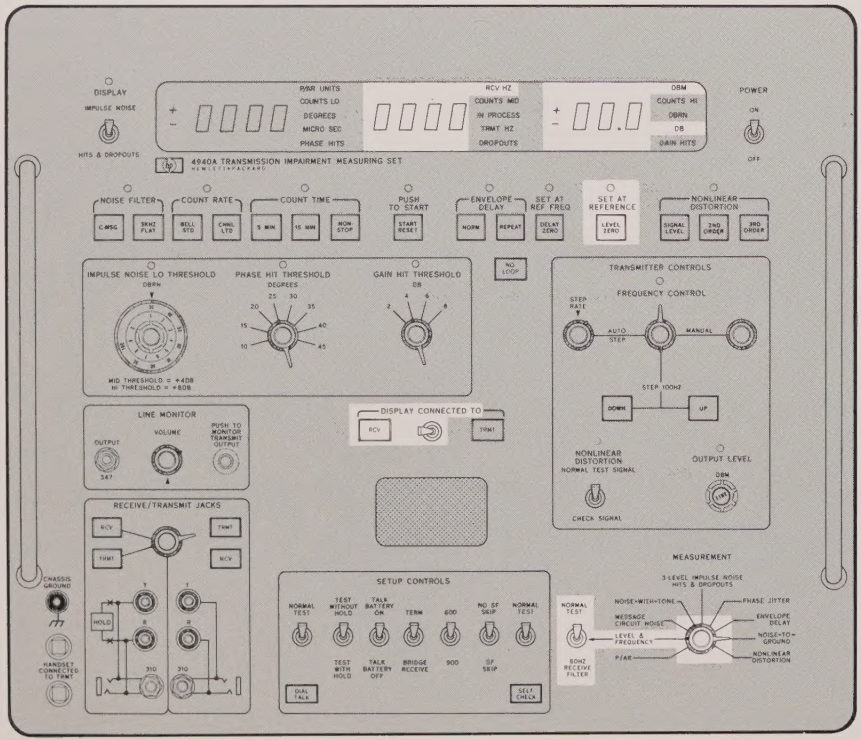
All transmission measurements should be made at Data Level. The Data Level for all presently specified data circuits is a power 13dB below the Transmission Level Point (TLP). For example, if the TLP is −16dB, the Data Level would be −29dBm. Therefore, an output level of −29dBm would be applied in this case.

5. When requested by the receiver operator, transmit the agreed upon test frequencies. When in the STEP 100 HZ FREQUENCY CONTROL mode, frequencies of 204Hz to 3904Hz can be selected in 100Hz increments by pressing the DOWN or UP push-buttons. Frequencies can also be stepped 100Hz automatically by rotating the FREQUENCY CONTROL switch to AUTO STEP and adjusting the STEP RATE control for the desired stepping rate. Frequencies other than those at the step points can be selected by rotating the FREQUENCY CONTROL switch to MANUAL and adjusting the MANUAL control for the desired frequency.

NOTE

If SF signaling units are used in the network under test, the SETUP CONTROLS key should be thrown to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450Hz and 2750Hz cannot be transmitted.

LIFT PAGE FOR RECEIVER PROCEDURES


DISPLAY
IMPULSE NOISE
HITS & DROPOUTS
P/AR UNITS
COUNTS LO
DEGREES
MICRO SEC
PHASE HITS
RCV HZ
COUNTS MID
IN PROCESS
TRMT HZ
DROPOUTS
DBM
COUNTS HI
DBRN
DB
GAIN HITS
POWER
ON
OFF
4940A TRANSMISSION IMPAIRMENT MEASURING SET
HEWLETT-PACKARD
NOISE FILTER
C-MSG
3KHZ FLAT
COUNT RATE
BELL STD
CMNL LTD
COUNT TIME
5 MIN
15 MIN
NON STOP
PUSH TO START
START RESET
ENVELOPE DELAY
NORM
REPEAT
SET AT REF FREQ
DELAY ZERO
SET AT REFERENCE
LEVEL ZERO
NONLINEAR DISTORTION
SIGNAL LEVEL
2ND ORDER
3RD ORDER
IMPULSE NOISE LO THRESHOLD
DBRN
MID THRESHOLD = +40B
HI THRESHOLD = +80B
PHASE HIT THRESHOLD
DEGREES
GAIN HIT THRESHOLD
DB
NO LOOP
TRANSMITTER CONTROLS
FREQUENCY CONTROL
STEP RATE
AUTO STEP
MANUAL
STEP 100HZ
DOWN
UP
NONLINEAR DISTORTION
NORMAL TEST SIGNAL
CHECK SIGNAL
OUTPUT LEVEL
DBM
LINE MONITOR
OUTPUT
VOLUME
PUSH TO MONITOR TRANSMIT OUTPUT
347
DISPLAY CONNECTED TO
RCV
TRMT
RECEIVE/TRANSMIT JACKS
RCV
TRMT
HOLD
310
CHASSIS GROUND
HANDSET CONNECTED TO TRMT
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
NORMAL TEST
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECEIVE
900
SF SKIP
DIAL TALK
SELF CHECK
MEASUREMENT
3-LEVEL IMPULSE NOISE HITS & DROPOUTS
NORMAL TEST
80HZ RECEIVE FILTER
NOISE+WITH+TONE
MESSAGE CIRCUIT NOISE
LEVEL & FREQUENCY
P/AR
PHASE JITTER
ENVELOPE DELAY
NOISE-TO-GROUND
NONLINEAR DISTORTION

LEVEL & FREQUENCY RECEIVER

1. Rotate MEASUREMENT switch to LEVEL & FREQUENCY.
2. Throw DISPLAY CONNECTED TO key to RCV.

1000 HZ LOSS MEASUREMENT

3. Instruct transmitter operator to send 1004 Hz tone.
4. Observe RCV HZ (nominally 1004 Hz) on center display and DBM received level on right display.
5. Depress 60 HZ RECEIVE FILTER key while observing DBM received level display. If received level changes more than ± 0.2 dBm, the 60 HZ RECEIVE FILTER key should be depressed throughout the measurement run.

FREQUENCY SHIFT MEASUREMENT

6. Observe RCV HZ while communicating with transmitter operator, comparing any difference between the transmitted and received frequency. The transmitting test set must be a TIMS, or other set capable of transmitting a signal known to within ± 0.5 Hz.

ATTENUATION DISTORTION MEASUREMENT

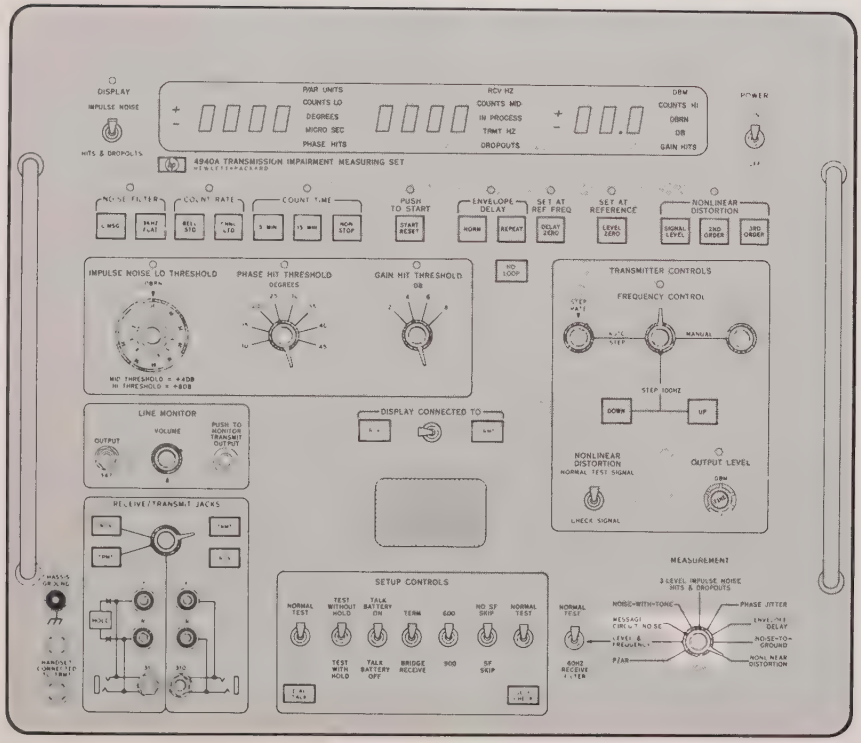
7. Press LEVEL ZERO push-button while receiving the reference frequency (e.g., 1004 Hz). This establishes a 0 dB reference.
8. Observe RCV HZ on center display and ±DB relative loss on right display as agreed upon frequencies are transmitted. +DB indicates more loss and −DB indicates less loss, relative to the reference frequency.

NOTE

If SF signaling units are used in the network under test, the transmitting test set should be operated in the SF SKIP mode. In this mode there will be no test signal as the transmitter frequency is adjusted through the 2450 Hz to 2750 Hz range.

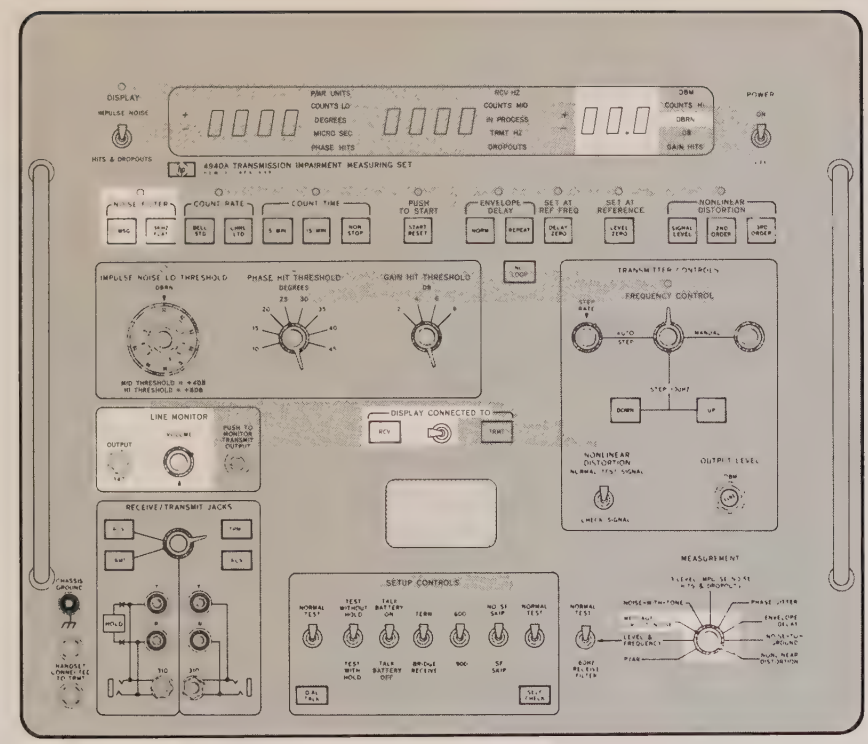
NOTE

Attenuation distortion measurements can also be made in absolute dBm units, if desired. The test set is automatically in the dBm mode until the LEVEL ZERO push-button is pressed. To return the test set to the dBm mode, momentarily rotate the MEASUREMENT switch out of the LEVEL & FREQUENCY position, then back again.



MESSAGE CIRCUIT NOISE
TRANSMITTER

1. Rotate MEASUREMENT switch to MESSAGE CIRCUIT NOISE. This provides the TRMT jacks with a quiet termination.

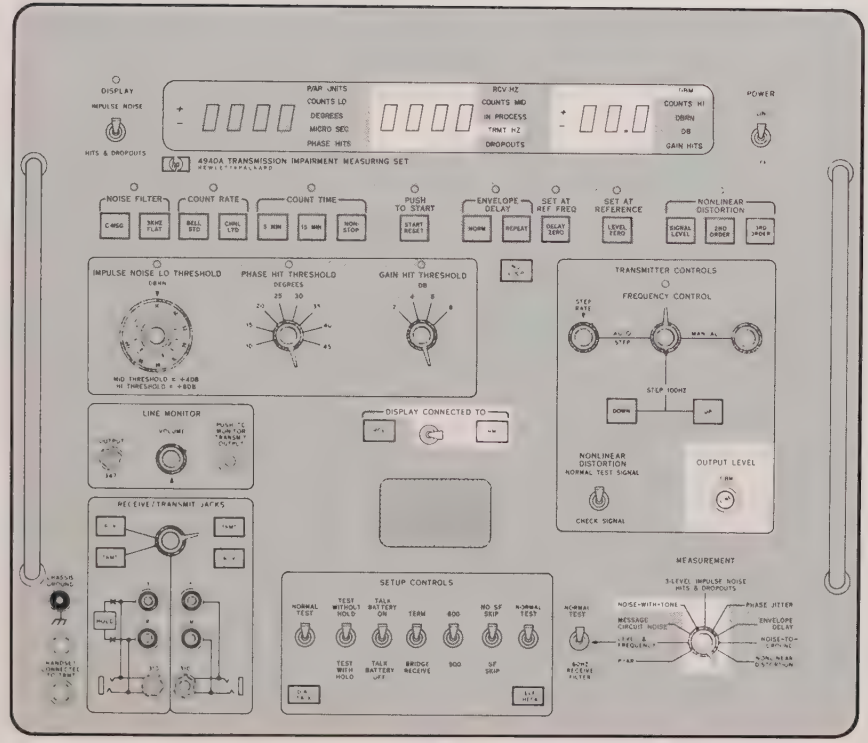


MESSAGE CIRCUIT NOISE
RECEIVER

1. Rotate MEASUREMENT switch to MESSAGE CIRCUIT NOISE.
2. Throw DISPLAY CONNECTED TO key to RCV.
3. Depress NOISE FILTER push-button (C-MSG or 3 KHZ FLAT) to select desired weighting.
4. Observe DBRN noise level on right display.

SINGLE FREQUENCY INTERFERENCE CHECK

5. Turn on LINE MONITOR by rotating VOLUME control until desired loudness is obtained in speaker or headphones. Listen for any predominant tone which will indicate a potential single frequency interference problem. A frequency selective voltmeter, spectrum analyzer, oscilloscope, etc., can be connected to the LINE MONITOR OUTPUT jack to further analyze the frequency and level of the interfering tone.

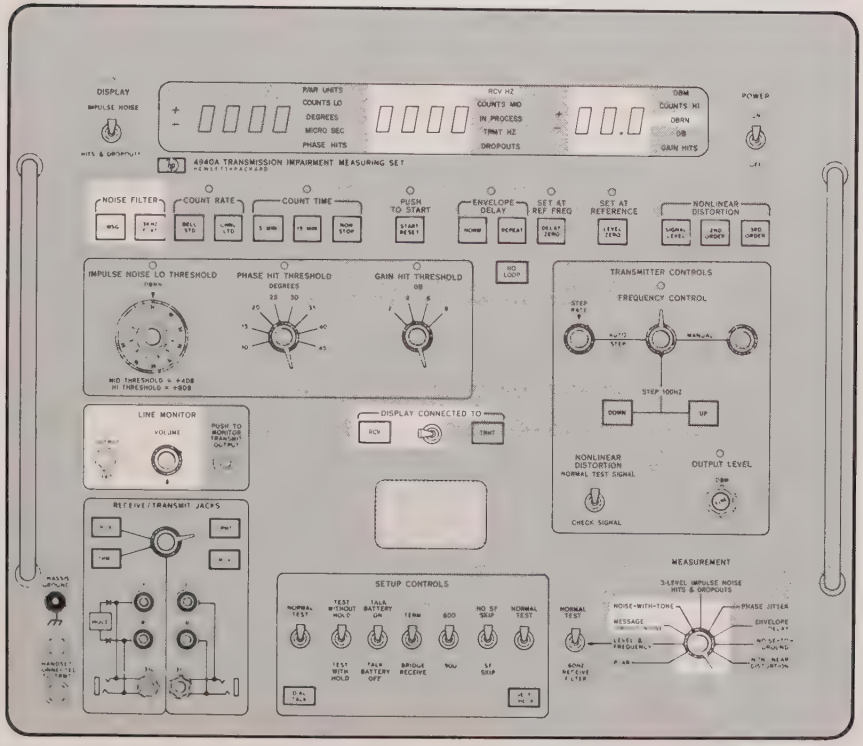

DISPLAY
IMPULSE NOISE
HITS & DROPOUTS
P/AR UNITS
COUNTS LO
DEGREES
MICRO SEC
PHASE HITS
RCV HZ
COUNTS MID
IN PROCESS
TRMT HZ
DROPOUTS
TRM
COUNTS HI
DBRN
DB
GAIN HITS
POWER
494DA TRANSMISSION IMPAIRMENT MEASURING SET
HEWLETT-PACKARD
NOISE FILTER
C-MSG
3KHZ FLAT
COUNT RATE
BELL 810
CHNL LTD
COUNT TIME
5 MIN
15 MIN
NON-STOP
PUSH TO START
START RESET
ENVELOPE DELAY
NORM
REPEAT
SET AT REF FREQ
DELAY ZERO
SET AT REFERENCE
LEVEL ZERO
NONLINEAR DISTORTION
SIGNAL LEVEL
2ND ORDER
3RD ORDER
IMPULSE NOISE LO THRESHOLD
DBRN
MID THRESHOLD = -44DB
HI THRESHOLD = -40DB
PHASE HIT THRESHOLD
DEGREES
GAIN HIT THRESHOLD
DB
TRANSMITTER CONTROLS
FREQUENCY CONTROL
STEP RATE
AUTO STEP
MAN ADJ
STEP 100HZ
DOWN
UP
NONLINEAR DISTORTION
NORMAL TEST SIGNAL
CHECK SIGNAL
OUTPUT LEVEL
TRM
LINE MONITOR
VOLUME
OUTPUT
PUSH TO MONITOR TRANSMIT OUTPUT
DISPLAY CONNECTED TO
RECEIVE/TRANSMIT JACKS
RCVR
TRMT
MUTE
CHASSIS GROUND
HANDSET CONNECTED TO DATA SET
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
NORMAL TEST
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECEIVE
900
SF SKIP
D.A. TALK
LIT HITS
MEASUREMENT
NORMAL TEST
3-LEVEL IMPULSE NOISE HITS & DROPOUTS
NOISE-WITH-TONE
MESSAGE CIRCUIT NOISE
LEVEL & FREQUENCY
PEAK
PHASE JITTER
ENVELOPE DELAY
NOISE-TO-CROSSTALK
NONLINEAR DISTORTION
404HZ RECEIVE FILTER

NOISE-WITH-TONE TRANSMITTER

1. Rotate MEASUREMENT switch to NOISE-WITH-TONE.
2. Throw DISPLAY CONNECTED TO key to TRMT.
3. Observe TRMT HZ on center display to verify that 1004 Hz holding tone is being transmitted.
4. Adjust OUTPUT LEVEL control for "Data Level" while observing DBM on right display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for all presently specified data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.


DISPLAY
IMPULSE NOISE
HITS & DROPOUTS
PWR UNITS
COUNTS LO
DEGREES
MICRO SEC
PHASE HITS
RCV HZ
COUNTS MID
IN PROCESS
TRMT HZ
DROPOUTS
DBM
COUNTS HI
DBRN
DB
GAIN HITS
POWER
4940A TRANSMISSION IMPAIRMENT MEASURING SET
HEWLETT-PACKARD
NOISE FILTER
COUNT RATE
COUNT TIME
PUSH TO START
ENVELOPE DELAY
SET AT REF FREQ
SET AT REFERENCE
NONLINEAR DISTORTION
IMPULSE NOISE LO THRESHOLD
PHASE HIT THRESHOLD
GAIN HIT THRESHOLD
NO LOOP
TRANSMITTER CONTROLS
FREQUENCY CONTROL
LINE MONITOR
VOLUME
DISPLAY CONNECTED TO
RCV
TRMT
RECEIVE/TRANSMIT JACKS
SETUP CONTROLS
MEASUREMENT
3-LEVEL IMPULSE NOISE
HITS & DROPOUTS
NONLINEAR DISTORTION
NORMAL TEST SIGNAL
CHECK SIGNAL
OUTPUT LEVEL

NOISE-WITH-TONE RECEIVER

1. Rotate MEASUREMENT switch to NOISE-WITH-TONE.
2. Throw DISPLAY CONNECTED TO key to RCV.
3. Depress NOISE FILTER push-button (C-MSG or 3 KHZ FLAT) to select desired weighting.
4. Observe RCV HZ on center display to verify that holding tone between 995 Hz and 1025 Hz is being received.
5. Turn on LINE MONITOR by rotating VOLUME control until desired loudness is obtained in speaker or headphones. Listen for any predominant tone which will indicate a potential single frequency interference problem.
6. Observe DBRN noise level on right display.

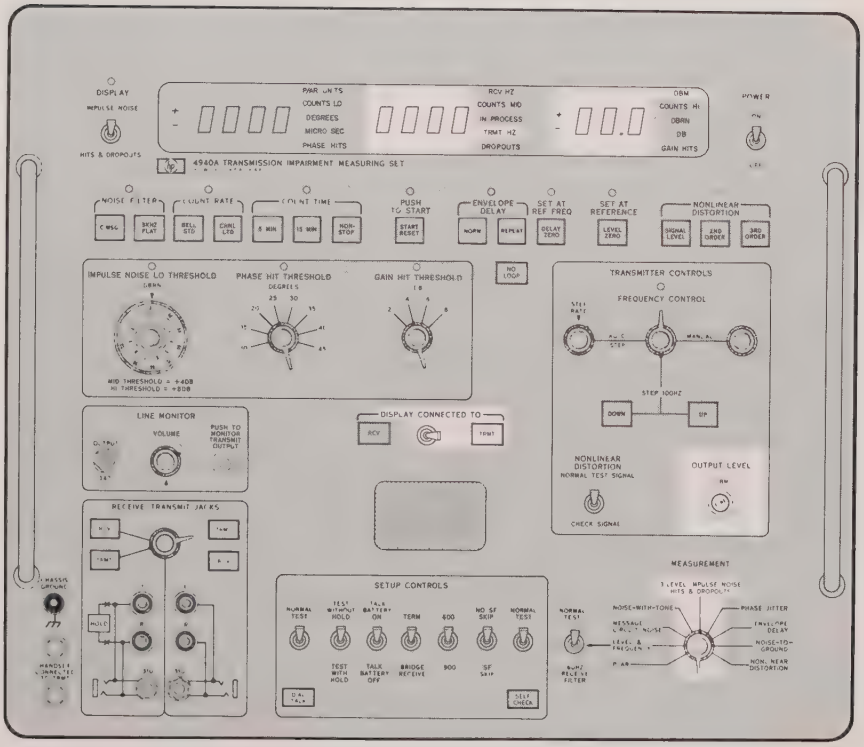
SIGNAL-TO-NOISE MEASUREMENT AND CALCULATION

7. Depress C-MSG NOISE FILTER push-button.
8. Observe DBRN noise level on right display and note this value.
9. Rotate MEASUREMENT switch to MESSAGE CIRCUIT NOISE.
10. Observe DBRN tone level on right display and note this value.
11. Subtract noise level noted in step 8 from tone level noted in step 10. The result is SIGNAL-TO-NOISE in dB.

Example:		
	Tone level (step 10)	74 dBrn
	−Noise level (step 8)	−50 dBrn
	= SIGNAL-TO-NOISE	= 24 dB

NOTE

This measurement cannot be made on a loop-around basis using one test set since it requires the transmitting test set to be set to NOISE-WITH-TONE while the receiving test set is set to MESSAGE CIRCUIT NOISE.


DISPLAY
IMPULSE NOISE
HITS & DROPOUTS
PWR UNITS
COUNTS LO
DEGREES
MICRO SEC
PHASE HITS
RCV HZ
COUNTS MID
IN PROCESS
TRMT HZ
DROPOUTS
DBM
COUNTS HI
DBRN
DB
GAIN HITS
POWER
ON
4940A TRANSMISSION IMPAIRMENT MEASURING SET
NOISE FILTER
C MSG
3KHZ FLAT
COUNT RATE
BELL STD
CHNL LTD
COUNT TIME
5 MIN
15 MIN
NON-STOP
PUSH TO START
START RESET
ENVELOPE DELAY
NORM
REPEAT
SET AT REF FREQ
DELAY ZERO
SET AT REFERENCE
LEVEL ZERO
NONLINEAR DISTORTION
SIGNAL LEVEL
2ND ORDER
3RD ORDER
IMPULSE NOISE LO THRESHOLD
DBRN
MID THRESHOLD = +40DB
HI THRESHOLD = +80DB
PHASE HIT THRESHOLD
DEGREES
GAIN HIT THRESHOLD
DB
NO LOOP
TRANSMITTER CONTROLS
FREQUENCY CONTROL
SELECT RATE
MAN. AL
STEP 100HZ
DOWN
UP
NONLINEAR DISTORTION
NORMAL TEST SIGNAL
CHECK SIGNAL
OUTPUT LEVEL
DBM
LINE MONITOR
VOLUME
PUSH TO MONITOR TRANSMIT OUTPUT
DISPLAY CONNECTED TO
RCV
TRMT
RECEIVE TRANSMIT JACKS
MEASUREMENT
1 LEVEL IMPULSE NOISE HITS & DROPOUTS
NOISE-WITH-TONE
MESSAGE CIRCUIT NOISE
LEVEL & FREQUEN
PHASE
PHASE JITTER
ENVELOPE DELAY
NOISE-TO-GROUND
NON-NEAR DISTORTION
NORMAL TEST
BAND RELEASE FILTER
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
NORMAL TEST
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECEIVE
900
SF SKIP
SELF CHECK
CHASSIS GROUND

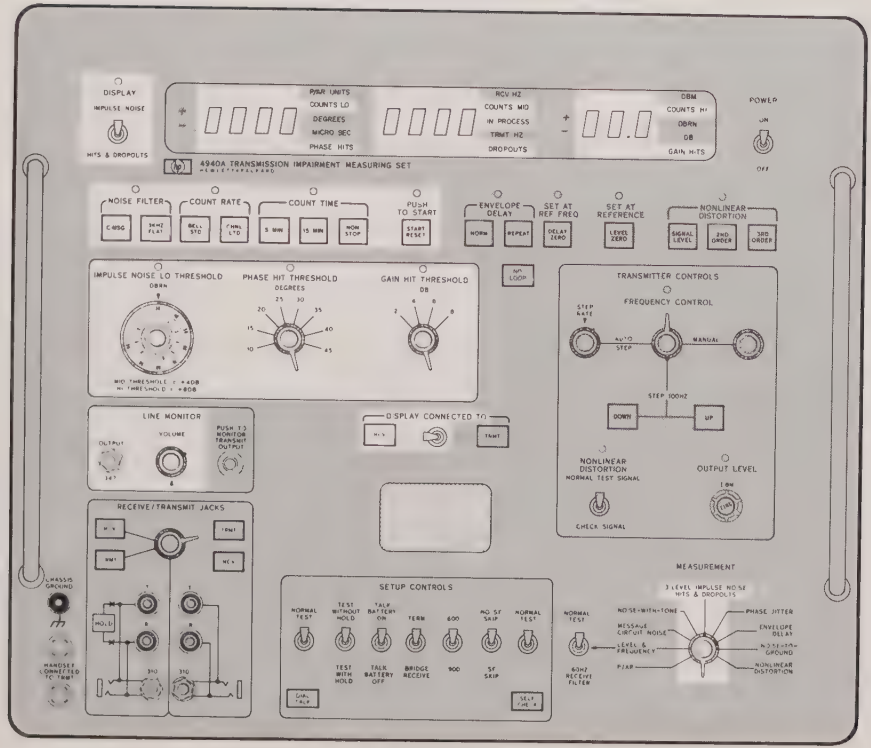
3-LEVEL IMPULSE NOISE, HITS & DROPOUTS
TRANSMITTER

1. Rotate MEASUREMENT switch to 3-LEVEL IMPULSE NOISE HITS & DROPOUTS.
2. Throw DISPLAY CONNECTED TO key to TRMT.
3. Observe TRMT HZ on center display to verify that 1004 Hz is being transmitted.
4. Adjust OUTPUT LEVEL control for "Data Level" while observing DBM on right display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for all presently specified data circuits is a power 13dB below the Transmission Level Point (TLP). For example, if the TLP is −16dBm, the Data Level would be −29dBm. Therefore, an output level of −29dBm would be applied in this case.

LIFT PAGE FOR RECEIVER PROCEDURES


DISPLAY
IMPULSE NOISE
HITS & DROPOUTS
PWR UNITS
COUNTS LO
DEGREES
MICRO SEC
PHASE HITS
RCV HZ
COUNTS MID
IN PROCESS
TRMT HZ
DROPOUTS
DBM
COUNTS HI
DBRN
DB
GAIN HITS
POWER
ON
OFF
4940A TRANSMISSION IMPAIRMENT MEASURING SET
NOISE FILTER
C-MSG
3KHZ FLAT
CNTRL STD
CNTRL LTD
COUNT RATE
COUNT TIME
5 MIN
15 MIN
NON STOP
PUSH TO START
START RESET
ENVELOPE DELAY
NORM
REPEAT
SET AT REF FREQ
DELAY ZERO
SET AT REFERENCE
LEVEL ZERO
NONLINEAR DISTORTION
SIGNAL LEVEL
2ND ORDER
3RD ORDER
IMPULSE NOISE LO THRESHOLD
DBRN
MID THRESHOLD = +40DB
HI THRESHOLD = +80B
PHASE HIT THRESHOLD
DEGREES
GAIN HIT THRESHOLD
DB
M-L LOOP
TRANSMITTER CONTROLS
FREQUENCY CONTROL
STEP RATE
AUTO STEP
MANUAL
STEP 100HZ
DOWN
UP
NONLINEAR DISTORTION NORMAL TEST SIGNAL
OUTPUT LEVEL
CHECK SIGNAL
LINE MONITOR
OUTPUT
VOLUME
PUSH TO MONITOR TRANSMIT OUTPUT
DISPLAY CONNECTED TO
RCV
TRMT
RECEIVE/TRANSMIT JACKS
RCV
TRMT
MON
MON
HOLD
310
310
CHASSIS GROUND
HANDSET CONNECTED TO TRMT
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
NORMAL TEST
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECEIVE
900
SF SKIP
SELF TEST
MEASUREMENT
3 LEVEL IMPULSE NOISE HITS & DROPOUTS
NORMAL TEST
60HZ RECEIVE FILTER
NOISE-WITH-TONE
MESSAGE CIRCUIT NOISE
LEVEL & FREQUENCY
PJAP
PHASE JITTER
ENVELOPE DELAY
NOISE-TO-GROUND
NONLINEAR DISTORTION

3-LEVEL IMPULSE NOISE, HITS & DROPOUTS
RECEIVER

1. Rotate MEASUREMENT switch to 3-LEVEL IMPULSE NOISE HITS & DROPOUTS.
2. Throw DISPLAY CONNECTED TO key to RCV.
3. Depress NOISE FILTER push-button (C-MSG or 3 KHZ FLAT) to select desired weighting.
4. Depress COUNT RATE push-button (BELL STD or CHNL LTD).
5. Depress COUNT TIME push-button (5 MIN, 15 MIN, or NON-STOP).
6. Rotate IMPULSE NOISE LO THRESHOLD switches to setting specified for the circuit under test.

NOTE

The general rule for determining the IMPULSE NOISE LO THRESHOLD setting is to add the threshold setting in dBrnCo (from the System Practice) to the TLP at the point of measurement.

7. Rotate PHASE HIT THRESHOLD switch to setting specified for the circuit under test.

NOTE

PHASE HIT THRESHOLD setting of 20 DEGREES recommended for most circuits. Consult applicable System Practice for specific recommendations.

8. Rotate GAIN HIT THRESHOLD switch to setting specified for the circuit under test.
9. Press START RESET push-button. The IN PROCESS annunciator will light for the duration of the count time.

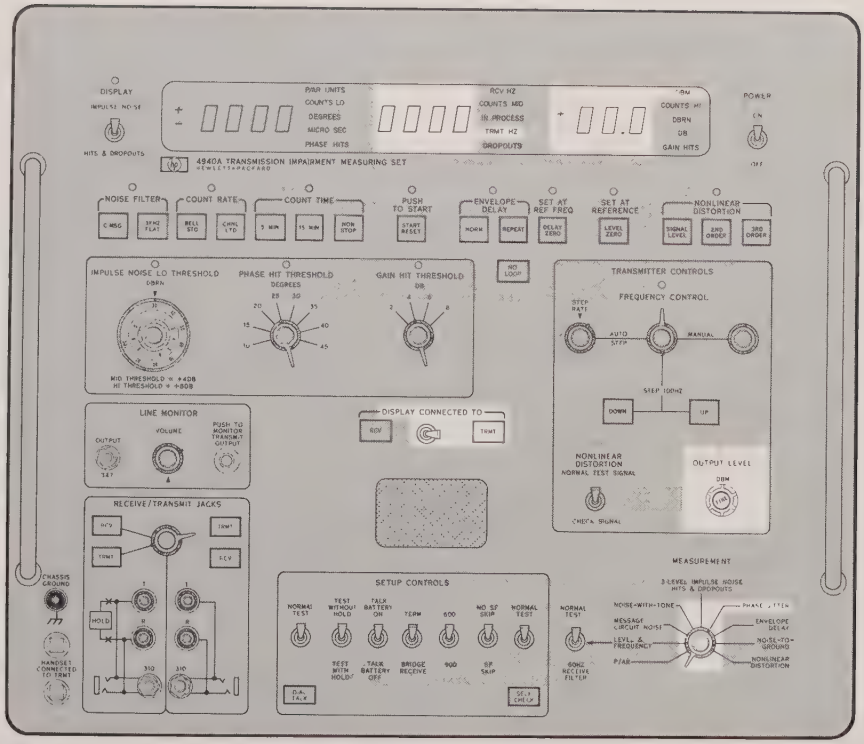
NOTE

The (—) sign in the right display may light up momentarily after the START RESET button is pressed and during counting whenever a dropout is counted. This is normal. However, if the (—) sign remains lighted, it is an indication that the proper test tone is not being received.

10. Turn on LINE MONITOR by rotating VOLUME control until desired loudness is obtained in speaker or headphones. Listen for any predominant noise which can provide a clue as to the noise source.
11. At any time during or after the count time, the accumulated counts for impulse noise can be observed by throwing the DISPLAY key to IMPULSE NOISE. GAIN HITS, PHASE HITS, and DROPOUTS can be observed by throwing the DISPLAY key to HITS & DROPOUTS.
12. When the IN PROCESS annunciator goes out the total counts for the measurements period can be observed.

NOTE

To stop counting before the count time is expired (or when in NON-STOP) without erasing the display totals, rotate the threshold level switches to their maximum settings.

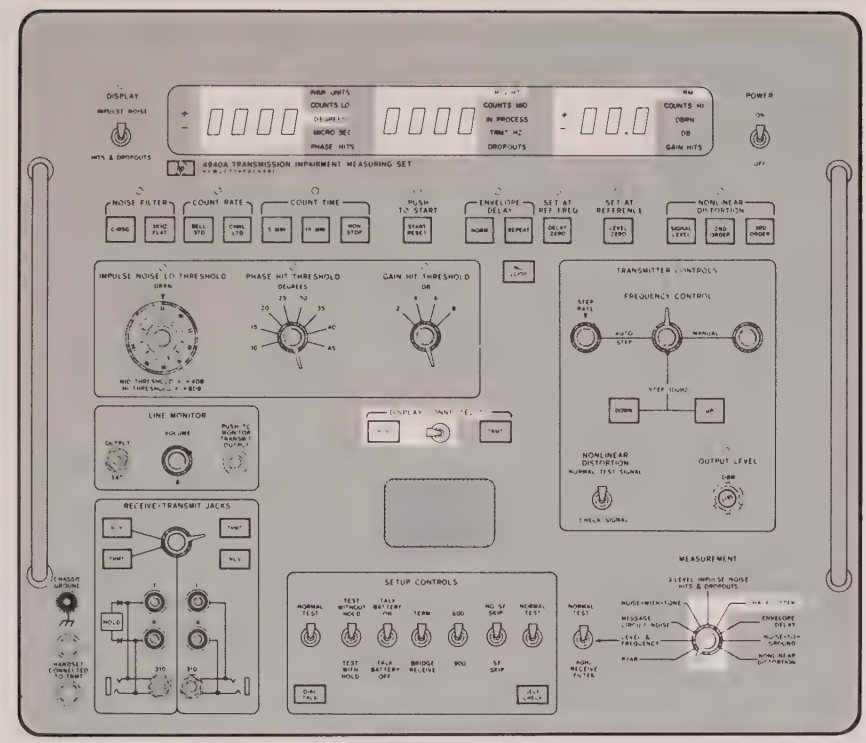


PHASE JITTER TRANSMITTER

1. Rotate MEASUREMENT switch to PHASE JITTER.
2. Throw DISPLAY CONNECTED TO key to TRMT.
3. Observe TRMT HZ on center display to verify that 1004Hz is being transmitted.
4. Adjust OUTPUT LEVEL control for "Data Level" while observing DBM on right display.

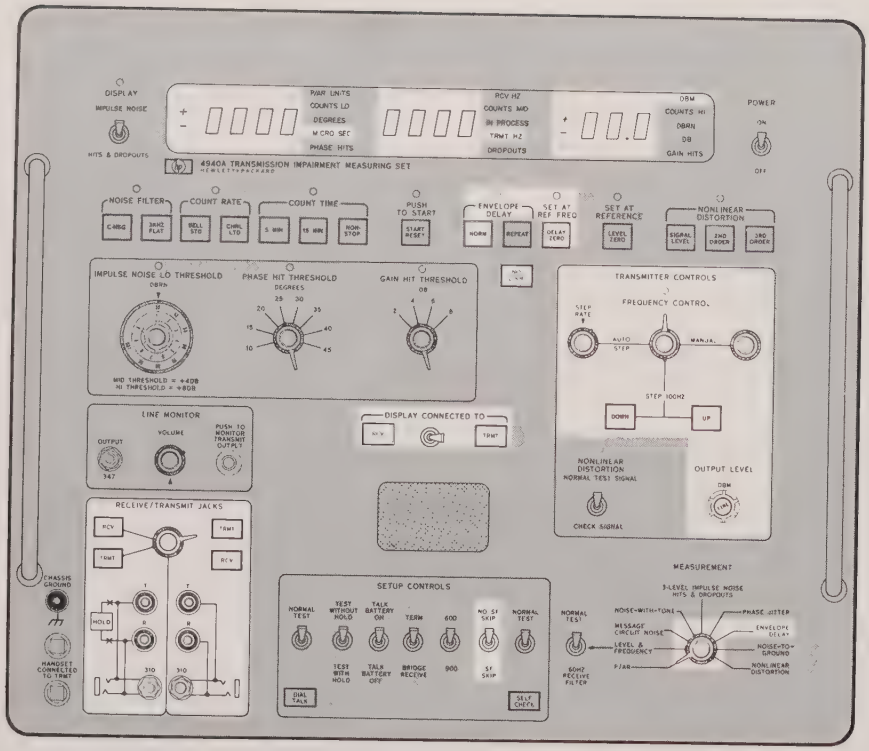
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for all presently specified data circuits is a power 13dB below the Transmission Level Point (TLP). For example, if the TLP is −16dB, the Data Level would be −29dBm. Therefore, an output level of −29dBm would be applied in this case.



PHASE JITTER
RECEIVER

1. Rotate MEASUREMENT switch to PHASE JITTER.
2. Throw DISPLAY CONNECTED TO key to RCV.
3. Observe DBM received level on right display. This level must be −40dBm or greater for a valid measurement to be made.
4. Observe RCV HZ on center display. This frequency must be between 990Hz and 1030Hz.
5. Observe DEGREES phase jitter on left display. If the readings vary, observe for an arithmetic mean (average). [Display of only a (+) sign indicates that phase jitter is more than 25°.]



ENVELOPE DELAY
NORMAL TEST SET

1. Connect line to be tested to TRMT jack and connect return reference line to RCV jack.
2. Rotate MEASUREMENT switch to ENVELOPE DELAY.
3. Throw DISPLAY CONNECTED TO key to TRMT.
4. Depress NORM ENVELOPE DELAY push-button.
5. Adjust OUTPUT LEVEL control for "Data Level" while observing DBM on right display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for all presently specified data circuits is a power 13dB below the Transmission Level Point (TLP). For example, if the TLP is −16dB, the Data Level would be −29dBm. Therefore, an output level of −29dBm would be applied in this case.

6. When the Repeat Test Set operator notifies you that he has adjusted to the desired transmission frequency (his Step 6 if Repeat Test Set is a TIMS), throw DISPLAY CONNECTED TO key to RCV.
7. Notify Repeat Test Set operator that you have completed your Step 6.

NOTE

Although the DISPLAY CONNECTED TO key is in the RCV mode, the center display will indicate TRMT HZ since this is the frequency of interest to the Normal Test Set operator.

8. Observe DBM on right display. This level must be −40dBm or greater for valid measurements.
9. Observe that NO LOOP annunciator is not lit.
10. Rotate FREQUENCY CONTROL switch to STEP 100HZ and set TRMT HZ on center display to reference frequency by pressing DOWN or UP push-buttons (e.g., 1804Hz, or frequency of minimum delay). Frequency can be set in MANUAL FREQUENCY CONTROL mode if necessary.
11. Observe ± MICRO SEC on left display. This reading may be very erratic for a few seconds until the loop stabilizes. When the display stabilizes so that only the units and tens digits are changing, press the DELAY ZERO push-button.

NOTE

This establishes a reference zero at the reference frequency. Typically, this reading will vary ±20 MICRO SEC. However, on very noisy circuits, the variation may be greater. A valid reference zero is established if these variations are evenly distributed above and below zero microseconds.

12. Observe TRMT HZ on center display. Select the desired test frequencies by pressing the STEP 100 HZ DOWN or UP push-buttons. Frequencies can also be stepped 100Hz automatically by rotating the FREQUENCY CONTROL switch to AUTO STEP and adjusting the STEP RATE control for the desired stepping rate. Frequencies other than those at the step points can be selected by rotating the FREQUENCY CONTROL switch to MANUAL and adjusting the MANUAL control for the desired frequency.

NOTE

If SF signaling units are used in the network under test, the SETUP CONTROLS key should be thrown to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450Hz and 2750Hz cannot be transmitted.

13. At each test frequency, observe ±MICRO SEC envelope delay on left display. If the readings vary, observe for an arithmetic mean (average).

NOTE

There are two conditions under which the test set will indicate to the operator that a valid envelope delay measurement cannot be made:

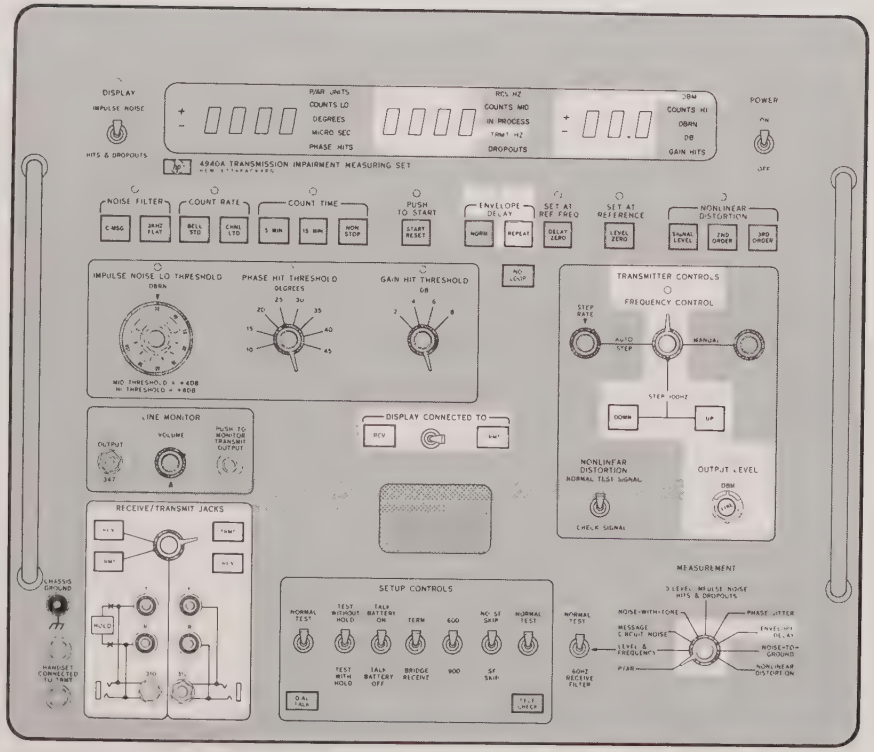
a. Under Range Condition: If the received level drops below −49dBm all three displays will blank and a (−) sign will appear in the right display. Usually the NO LOOP annunciator will also light up. This is a normal condition when the test set is in SF SKIP mode and the transmitter frequency controls are set in the 2450Hz to 2750Hz range. To clear this condition, merely readjust the frequency to outside the skip range. Measurements can proceed as soon as the MICRO SEC display stabilizes.

b. NO LOOP Condition: If the 83-1/3 Hz modulation frequency is lost the NO LOOP annunciator will light up. Whenever there is a signal loss due to a broken loop, the cause must be identified and corrected. When the loop is restored, measurements can proceed as soon as the MICRO SEC display stabilizes.

NOTE

The reference delay zero will be lost if the Normal Test Set's MEASUREMENT switch or DELAY ZERO push-button are disturbed. It will be necessary to return to Steps 10 and 11 to re-establish the reference zero.

LIFT PAGE FOR REPEAT TEST SET PROCEDURES


DISPLAY
IMPULSE NOISE
HITS & DROPOUTS
P/AR UNITS
COUNTS LO
DEGREES
MICRO SEC
PHASE HITS
RCV HZ
COUNTS MID
IN PROCESS
XMIT HZ
DROPOUTS
DBM
COUNTS HI
DBRN
DB
GAIN HITS
POWER
ON
OFF
4940A TRANSMISSION IMPAIRMENT MEASURING SET
NOISE FILTER
C MSG
3KHZ FLAT
BELL STD
CHAN LTD
COUNT RATE
COUNT TIME
5 MIN
15 MIN
NON STOP
PUSH TO START
START RESET
ENVELOPE DELAY
NORM
REPEAT
SET AT REF FREQ
DELAY ZERO
SET AT REFERENCE
LEVEL ZERO
NONLINEAR DISTORTION
SIGNAL LEVEL
2ND ORDER
3RD ORDER
IMPULSE NOISE LO THRESHOLD
DBRN
MID THRESHOLD = +40B
HI THRESHOLD = +60B
PHASE HIT THRESHOLD
DEGREES
GAIN HIT THRESHOLD
DB
NO LSNR
TRANSMITTER CONTROLS
FREQUENCY CONTROL
STEP RATE
AUTO STEP
MANUAL
STEP 100HZ
DOWN
UP
NONLINEAR DISTORTION
NORMAL TEST SIGNAL
CHECK SIGNAL
OUTPUT LEVEL
DBM
LINE MONITOR
VOLUME
OUTPUT
347
PUSH TO MONITOR TRANSMIT OUTPUT
DISPLAY CONNECTED TO
RCV
XMT
RECEIVE/TRANSMIT JACKS
CHASSIS GROUND
HANDSET CONNECTED TO XMT
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECENT
900
SF SKIP
O.H. TALK
TEST CHECK
MEASUREMENT
3 LEVEL IMPULSE NOISE HITS & DROPOUTS
NOISE-WITH-TONE
MESSAGE CIRCUIT NOISE
LEVEL & FREQUENCY
P/AR
PHASE JITTER
ENVELOPE DELAY
NOISE-TO-GROUND
NONLINEAR DISTORTION
60HZ RECEIVE FILTER

ENVELOPE DELAY
REPEAT TEST SET

1. Connect line to be tested to RCV jack and connect return reference line to TRMT jack.
2. Rotate MEASUREMENT switch to ENVELOPE DELAY.
3. Throw DISPLAY CONNECTED TO key to TRMT.
4. Depress REPEAT ENVELOPE DELAY push-button.
5. Adjust OUTPUT LEVEL control for "Data Level" while observing DBM on right display.

DATA LEVEL

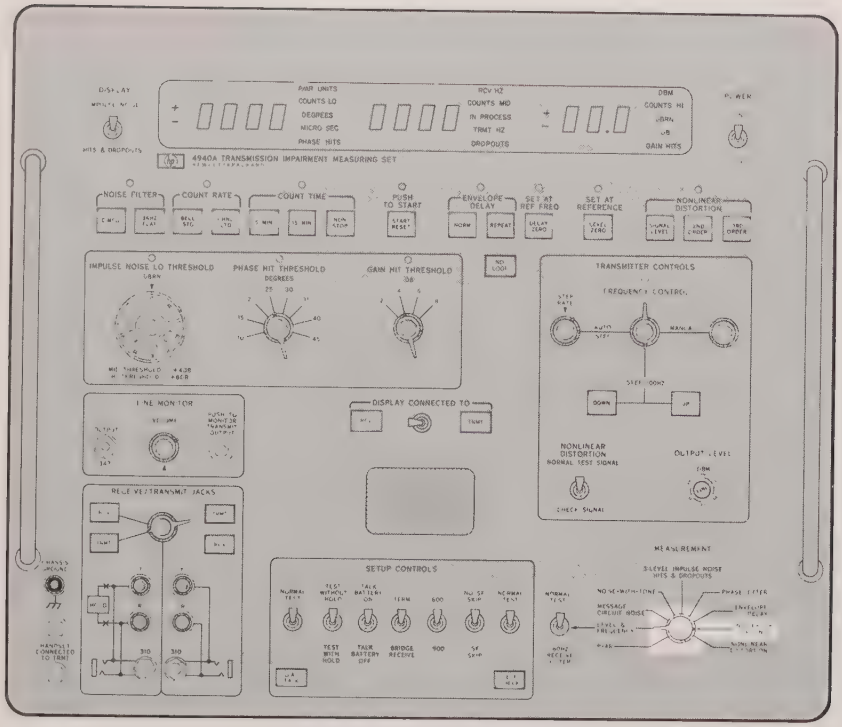
All transmission measurements should be made at Data Level. The Data Level for all presently specified data circuits is a power 13dB below the Transmission Level Point (TLP). For example, if the TLP is −16dB, the Data Level would be −29dBm. Therefore, an output level of −29dBm would be applied in this case.

6. Rotate FREQUENCY CONTROL switch to STEP 100 HZ and set TRMT HZ on center display for desired transmission frequency on reference channel (e.g., 1804Hz) by pressing DOWN or UP push-buttons.
7. Notify Normal Test Set operator that you have completed your Step 6.
8. When Normal Test Set operator notifies you that he has completed his Step 6 (if Normal Test Set is a TIMS), throw DISPLAY CONNECTED TO key to RCV.

NOTE

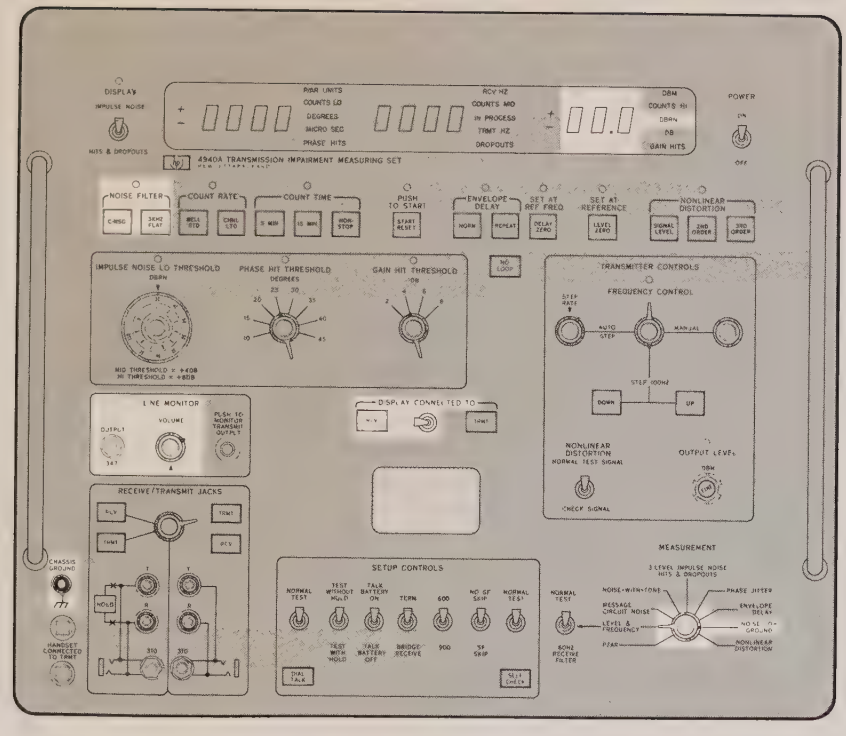
If the DISPLAY CONNECTED TO key is thrown back to TRMT at any time during the envelope delay measurements, the loop will be broken and the Normal Test Set will display erroneous measurement information.

9. Monitor DBM received level on right display to be sure it remains −40dBm or greater throughout the measurements.



NOISE-TO-GROUND TRANSMITTER

1. Rotate MEASUREMENT switch to NOISE-TO-GROUND. This provides the TRMT jacks with a quiet termination.



NOISE-TO-GROUND RECEIVER

NOTE

The test set must be properly grounded for valid noise-to-ground measurements. Ground can be established through the power cord ground if there is a reliable power line bond; through the sleeve connections on the 310 RECEIVE/TRANSMIT JACKS; or by connecting the CHASSIS GROUND post to a known good ground.

1. Rotate MEASUREMENT switch to NOISE-TO-GROUND.
2. Throw DISPLAY CONNECTED TO key to RCV.
3. Depress NOISE FILTER button (C-MSG or 3KHZ FLAT) to select desired weighting.
4. Observe DBRN noise level on right display.

NOTE

TIMS provides actual noise-to-ground readings in dBrn. It is not necessary to add 40dB to the readings.

5. Turn on LINE MONITOR by rotating VOLUME control until desired loudness is obtained in speaker or headphones. Listen for any predominant tone which can provide a clue as to the noise source.

NOTE

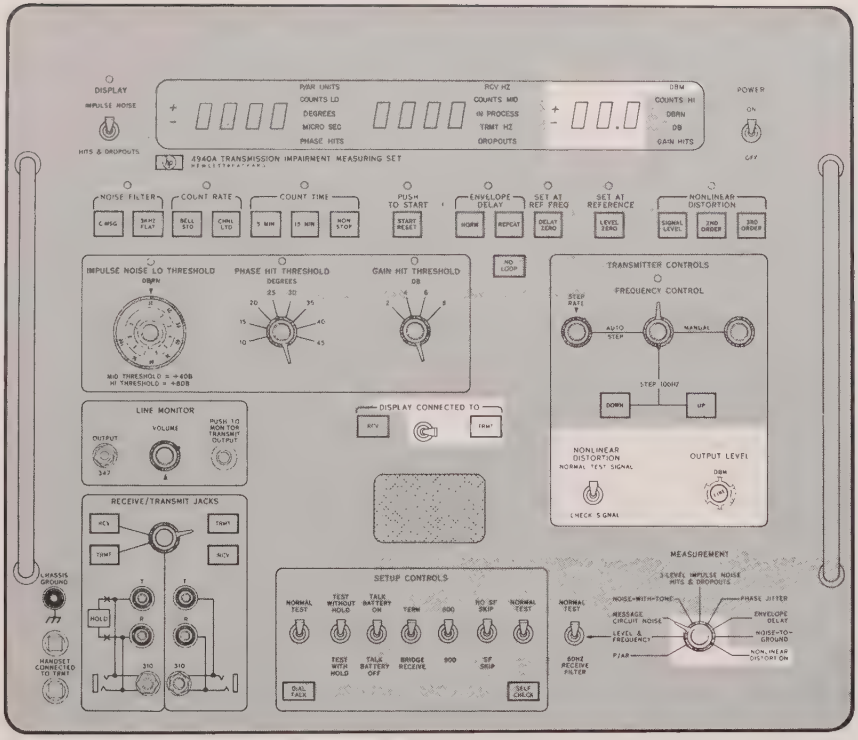
This measurement is valid only on metallic (physical) circuits (end loops).

LINE BALANCE CALCULATION

6. A figure of merit for line balance can be calculated by measuring message circuit noise (N_m) and noise-to-ground (N_g) and applying the formula: Balance in dB = $N_m - N_g$ *(Note that it is not necessary to add 40dB to N_g in this equation.)*

NOTE

It is recommended that both of these measurements be made using the 3KHZ FLAT NOISE FILTER to account for the effects of power line related noise.



NONLINEAR DISTORTION (Optional)
TRANSMITTER

1. Rotate MEASUREMENT switch to NONLINEAR DISTORTION.
2. Throw DISPLAY CONNECTED TO key to TRMT.
3. Adjust OUTPUT LEVEL control for "Data Level" while observing DBM on right display.

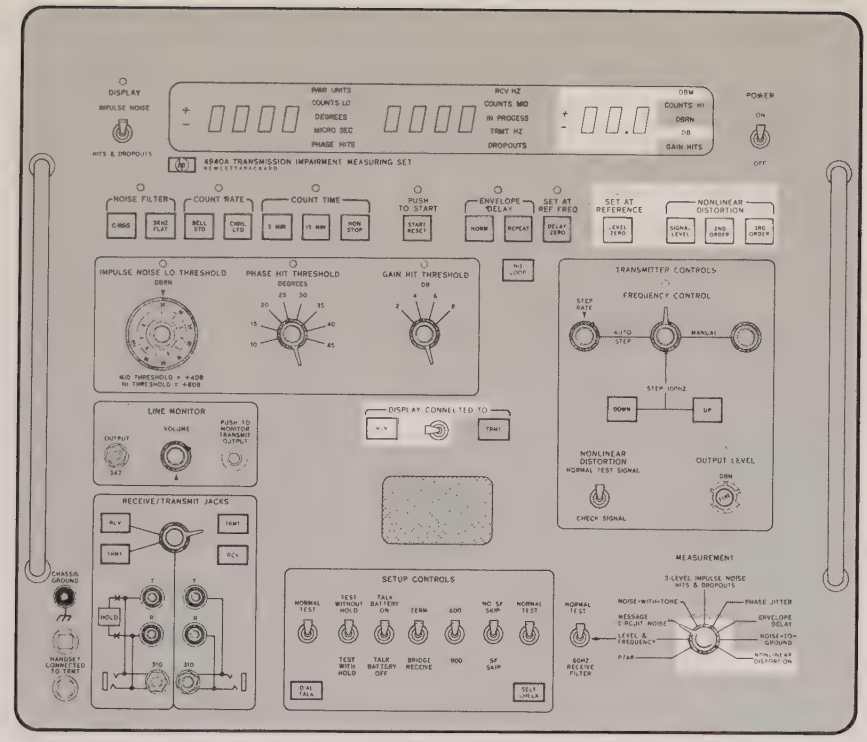
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for all presently specified data circuits is a power 13dB below the Transmission Level Point (TLP). For example, if the TLP is −16dB, the Data Level would be −29dBm. Therefore, an output level of −29dBm would be applied in this case.

NOTE

Maximum output level for nonlinear distortion is 0dBm.

4. When requested by receiver operator, hold NONLINEAR DISTORTION key in CHECK SIGNAL position.



NONLINEAR DISTORTION (Optional)
RECEIVER

1. Rotate MEASUREMENT switch to NONLINEAR DISTORTION.
2. Throw DISPLAY CONNECTED TO key to RCV.
3. Depress SIGNAL LEVEL push-button.
4. Observe DBM received level on right display. This level must be −35 dBm or greater for a valid measurement.

NOTE

The received level may take 15-20 seconds to stabilize.

5. Press LEVEL ZERO push-button. This establishes a 0dB reference so distortion products can be measured in dB relative to signal level.
6. Depress 2ND ORDER push-button.
7. Observe DB normal test signal level on right display (note this number).
8. Instruct transmitter operator to send CHECK SIGNAL.
9. Observe DB check signal level on right display (note this number).
10. Subtract check signal level reading (Step 9) from normal test signal level reading (Step 7). Refer to NOISE CORRECTION TABLE (use dB Relative column) and add the appropriate correction factor to the normal test signal reading. The result is NONLINEAR DISTORTION in dB.
11. Depress 3RD ORDER push-button and repeat Steps 7 through 10 to determine the 3rd order distortion level.

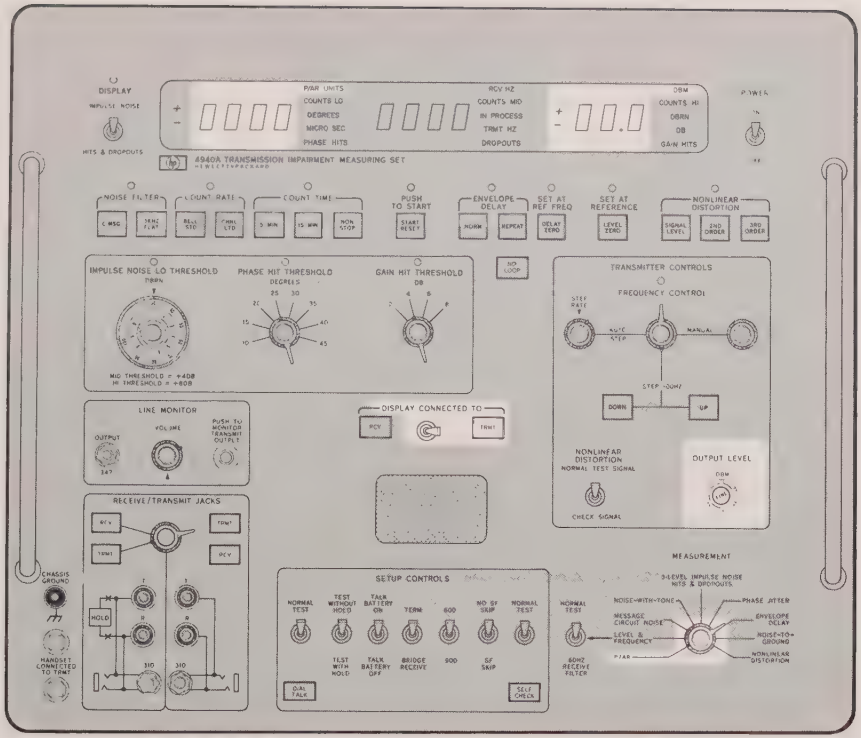
MEASURING DBM ABSOLUTE SIGNAL LEVEL

12. If measurement of distortion products directly in dBm is desired, do not perform Step 5. Proceed with Steps 6 through 11, observing DBM levels on right display. Use dBm Absolute column of NOISE CORRECTION TABLE and subtract the appropriate correction factor from the normal test signal reading.

NONLINEAR DISTORTION NOISE CORRECTION TABLE

Corrections to be made to 2nd and 3rd Order Nonlinear Distortion Measurements to correct for presence of noise		
dB difference between normal test signal and check signal readings	dB Relative Add to normal test signal reading	dBm Absolute Subtract from normal test signal reading
0	*	*
1	7	7
2	4	4
3	3	3
4-5	2	2
6-8	1	1
Over 8	0	0

*Zero difference indicates that distortion level is buried in noise. This can be interpreted as either extremely low distortion, or extremely high noise and should be further investigated.



P/AR (Optional)
TRANSMITTER

1. Rotate MEASUREMENT switch to P/AR.
2. Throw DISPLAY CONNECTED TO key to TRMT.
3. Adjust OUTPUT LEVEL control for "Data Level" while observing DBM on right display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for all presently specified data circuits is a power 13dB below the Transmission Level Point (TLP). For example, if the TLP is −16dB, the Data Level would be −29dBm. Therefore, an output level of −29dBm would be applied in this case.

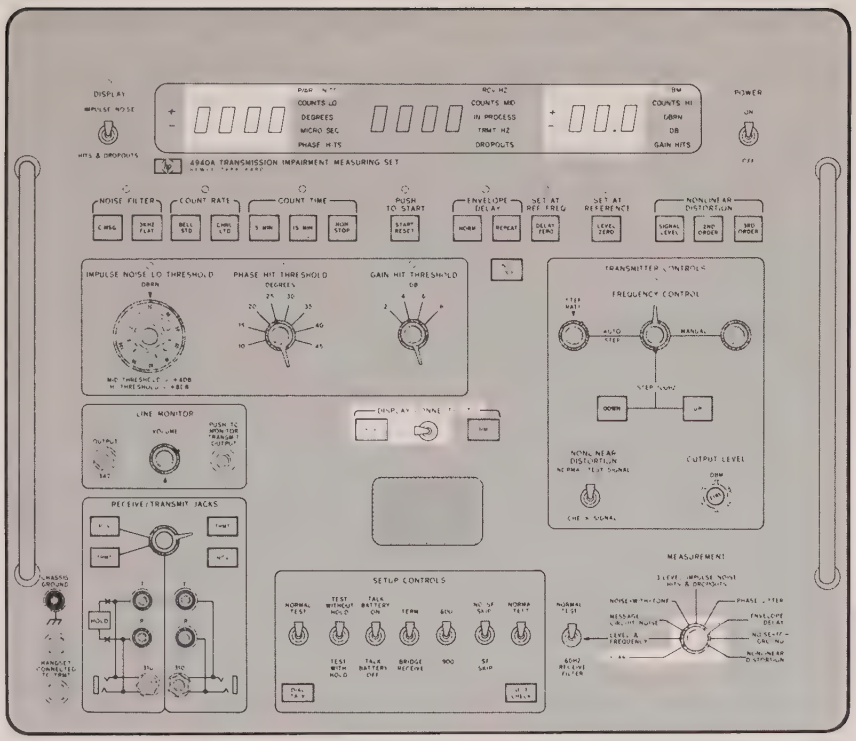
NOTE

Maximum output for P/AR is 0 dBm.

4. Observe P/AR UNITS on left display and verify transmission of 99 to 101 P/AR units.

NOTE

The above P/AR measurement has been designed to improved specifications which overcome the effects of frequency translation and other phenomena; therefore, the TIMS P/AR measurement may not be compatible with other P/AR test sets.

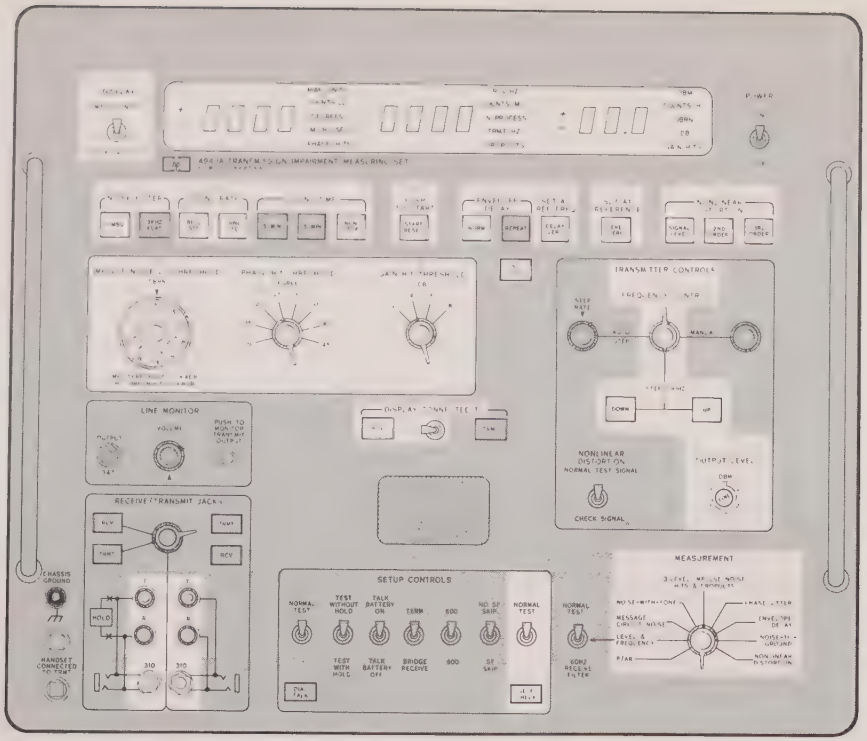


P/AR (Optional)
RECEIVER

1. Rotate MEASUREMENT switch to P/AR.
2. Throw DISPLAY CONNECTED TO key to RCV.
3. Observe DBM received level on right display. This level must be –40dBm or greater for a valid measurement.
4. Observe P/AR UNITS on left display.

NOTE

The above P/AR measurement has been designed to improved specifications which overcome the effects of frequency translation and other phenomena; therefore, the TIMS P/AR measurement may not be compatible with other P/AR test sets.



SELF-CHECK

NOTE

The SELF CHECK procedure should be performed periodically to verify performance of the test set. SELF CHECK is recommended before transporting the test set to a remote testing site; or whenever there is any doubt about transmission measurement results. Failure of the test set to pass any SELF CHECK indicates a malfunction that can possibly affect other measurements. It is therefore recommended that a complete SELF CHECK always be performed to determine which measurement modes are valid.

1. PRELIMINARY SETUP:
   a. Disconnect test set from on-line testing.
   b. Loop TRMT jack to RCV jack.
   c. Throw far right-hand SETUP CONTROLS key to SELF CHECK. Throw all other SETUP CONTROLS keys to up position.
   d. Throw DISPLAY CONNECTED TO key to RCV.

2. P/AR SELF CHECK (Optional):
   a. Rotate MEASUREMENT switch to P/AR.
   b. Verify a reading of 99 to 101 P/AR UNITS on left display.
   c. Verify a reading of −1 to +1 DBM on right display.

3. LEVEL & FREQUENCY SELF CHECK:
   a. Rotate MEASUREMENT switch to LEVEL & FREQUENCY.
   b. Rotate FREQUENCY CONTROL switch to STEP 100 HZ.
   c. Verify a reading of 1004 RCV HZ on center display.
   d. Verify a reading of −0.2 to +0.2 DBM on right display.

4. MESSAGE CIRCUIT NOISE AND INDICATOR LAMPS SELF CHECK:
   a. Rotate MEASUREMENT switch to MESSAGE CIRCUIT NOISE.
   b. Depress C-MSG NOISE FILTER push-button.
   c. Verify a reading of 89 to 91 DBRN on right display.
   d. Verify that all 15 indicator dot lamps are lit.

5. NOISE-WITH-TONE SELF CHECK:
   a. Rotate MEASUREMENT switch to NOISE-WITH-TONE.
   b. Depress C-MSG NOISE FILTER push-button.
   c. Verify a reading of 58 to 62 DBRN on right display at the end of one minute.
   d. Verify a reading of 1003 to 1005 RCV HZ on center display.

6. 3-LEVEL IMPULSE NOISE HITS & DROPOUTS SELF-CHECK:
   a. Rotate MEASUREMENT switch to 3-LEVEL IMPULSE NOISE HITS & DROPOUTS.
   b. Depress C-MSG NOISE FILTER push-button.
   c. Depress BELL STD COUNT RATE push-button.
   d. Depress NON-STOP COUNT TIME push-button.
   e. Throw DISPLAY key to IMPULSE NOISE.
   f. Rotate IMPULSE NOISE LO THRESHOLD switch to 69 DBRN.
   g. Wait 30 seconds, then press START RESET push-button and verify that IN PROCESS annunciator is lit.
   h. Decrease IMPULSE NOISE LO THRESHOLD switch setting one dBrn at a time until COUNTS LO on left display start counting at a rate of at least one count per second. Verify that this setting is 62 to 66 dBrn.
   i. Continue to decrease IMPULSE NOISE LO THRESHOLD switch setting one dBrn at a time until COUNTS MID on center display start counting at a rate of at least one count per second. Verify that this setting is 3 to 5 dBrn below the setting in Step h.
   j. Continue to decrease IMPULSE NOISE LO THRESHOLD switch setting one dBrn at a time until COUNTS HI on right display start counting at a rate of at least one count per second. Verify that this setting is 7 to 9 dBrn below the setting in Step h.
   k. Verify that all counts accumulate by 1's.

NOTE

Although each display will be counting by 1s, they will not necessarily count at the same rate. It is not unusual to have different counts for COUNTS LO, COUNTS MID, and COUNTS HI.

   l. Depress CHNL LTD COUNT RATE push-button.
   m. Press START RESET push-button and verify that counts are now changing at a much greater rate than before.
   n. Throw DISPLAY key to HITS & DROPOUTS
   o. Rotate GAIN HIT THRESHOLD switch to 2 DB.
   p. Rotate PHASE HIT THRESHOLD switch to 15 DEGREES.
   q. Press START RESET push-button and verify that PHASE HITS and GAIN HITS accumulate by 2's and that DROPOUTS accumulate by 1's. A (—) sign should flash in the right display for every dropout that is counted.
   r. Rotate GAIN HIT THRESHOLD switch to 4 DB and verify that GAIN HITS stop being counted. Return GAIN HIT THRESHHOLD switch to 2 DB.
   s. Rotate PHASE HIT THRESHOLD switch to 20 DEGREES and verify that PHASE HITS stop being counted. Return PHASE HIT THRESHOLD switch to 15 DEGREES.
   t. Depress BELL STD COUNT RATE push-button.
   u. Press START RESET push-button and verify that PHASE HITS, DROPOUTS, and GAIN HITS accumulate by 1's.

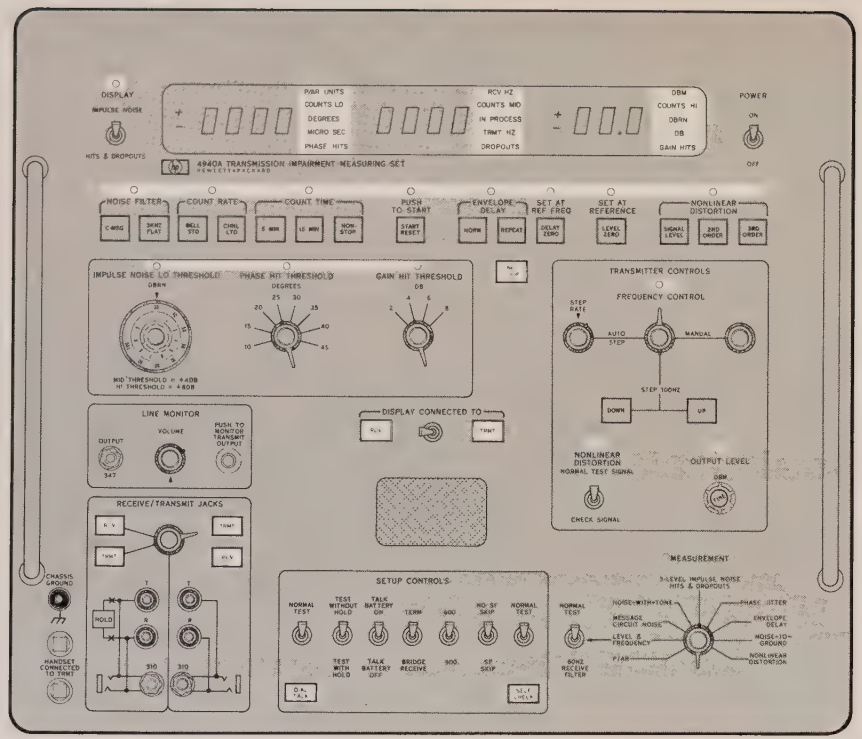
7. PHASE JITTER SELF CHECK:
   a. Rotate MEASUREMENT switch to PHASE JITTER.
   b. Verify a reading of 10.6 to 12.2 DEGREES on left display at the end of one minute.
   c. Verify a reading of 999 to 1009 RCV HZ on center display.
   d. Verify a reading of −1 to +1 DBM on right display.

SELF CHECK CONTINUED — LIFT PAGE

8. ENVELOPE DELAY SELF CHECK:
   a. Rotate MEASUREMENT switch to ENVELOPE DELAY.
   b. Throw far right-hand SETUP CONTROLS key to NORMAL TEST.
   c. Depress NORM ENVELOPE DELAY push-button.
   d. Set frequency to 1004 TRMT HZ on center display by pressing STEP 100 HZ UP or DOWN push-buttons.
   e. Set OUTPUT LEVEL to 0 DBM on right display.
   f. Wait 15 seconds, then press DELAY ZERO push-button.
   g. Throw far right-hand SETUP CONTROLS key to SELF CHECK.
   h. Verify a reading of 2995 to 3005 MICRO SEC on left display at the end of 15 seconds.
   i. Verify a reading of −0.2 to +0.2 DBM on right display.
   j. Disconnect loop cord from TRANSMIT/RECEIVE JACKS. Verify that NO LOOP annunciator is lit, that all displays are blank, and that a (−) sign appears in the right display. Reconnect loop cord.

9. NOISE-TO-GROUND SELF CHECK:
   a. Rotate MEASUREMENT switch to NOISE-TO-GROUND.
   b. Depress C-MSG NOISE FILTER push-button.
   c. Verify a reading of 83 to 85 DBRN on right display.

10. NONLINEAR DISTORTION SELF CHECK (Optional):
   a. Rotate MEASUREMENT switch to NONLINEAR DISTORTION.
   b. Depress SIGNAL LEVEL push-button.
   c. Verify a reading of −1 to +1 DBM on right display at the end of 15 seconds.
   d. Press LEVEL ZERO push-button.
   e. Verify a reading of −0 DB on right display.
   f. Depress 2ND ORDER push-button.
   g. Verify a reading of +6 to +8 DB on right display at the end of 15 seconds.
   h. Depress 3RD ORDER push-button.
   i. Verify a reading of +6 to +8 DB on right display at the end of 15 seconds.



LAMP CHECKS AND REPLACEMENT

1. INDICATOR DOT LAMPS CHECK:
   a. Refer to MESSAGE CIRCUIT NOISE SELF CHECK.

NOTE

Replacement of indicator dot lamps requires special equipment and procedures and should be performed only by authorized repair shops.

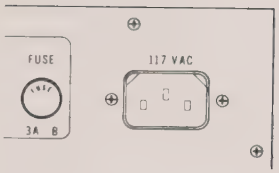
2. DISPLAY ANNUNCIATOR LAMPS CHECK:
   a. Display annunciator lamps can be checked while performing SELF CHECK procedures.
   b. Verify that all display annunciator lamps illuminate evenly. Each annunciator employs two lamps for backup reliability; therefore, uneven illumination may indicate a burned out lamp.

NOTE

Replacement of display annunciator lamps requires special equipment and procedures and should be performed only by authorized repair shops.

3. PANEL ANNUNCIATOR LAMPS CHECK:
   a. Rotate RECEIVE/TRANSMIT JACKS switch and verify that both sets of RCV and TRMT annunciator lamps light properly.
   b. Throw DISPLAY CONNECTED TO key between RCV and TRMT positions and verify that RCV and TRMT lamps light properly.
   c. Throw SETUP CONTROLS key to DIAL/TALK and verify that DIAL/TALK lamp lights properly.
   d. Throw SETUP CONTROLS key to SELF CHECK and verify that SELF CHECK lamp lights properly.
   e. Refer to ENVELOPE DELAY SELF CHECK to verify that NO LOOP lamp lights properly.

4. PANEL ANNUNCIATOR LAMPS REPLACEMENT:
   a. Switch POWER off.
   b. Insert fingernail in indentation at bottom of lens cap and pry up and out to remove lens cap.
   c. Gently grasp lamp base with needle-nose pliers and pull up and out to remove lamp.
   d. Insert new lamp with needle-nose pliers and replace lens cap. A spare lamp is located in the test set cover. In the rack mount versions, the spare lamp is located on the panel above the test set. Replace lamp with HP Part No. 2140-0405. (Oshino OL-685BPC, or equivalent).

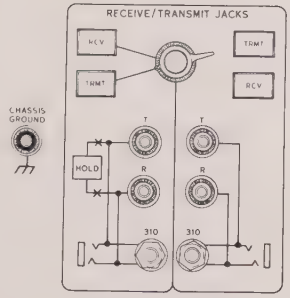


POWER CORD RECEPTACLE AND FUSE

117V AC (± 10%) 60Hz power is applied to the test set through the male power cord receptacle located on top of the test set. AC line fusing is provided by a 3 Amp (Slo Blo) fuse located in the fuse holder next to the power receptacle. A spare fuse is located in the test set cover. In the rack mount versions, the spare fuse is located on the panel above the test set.

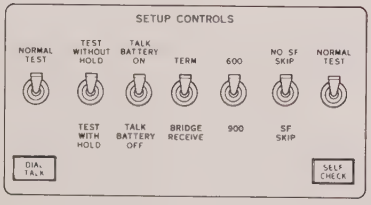
POWER SWITCH

POWER toggle switch turns the test set ON and OFF.



RECEIVE/TRANSMIT JACKS

A two position rotary switch is used to reverse the connections of the left and right jack fields. When the switch is in the up position, the left jacks are connected for RCV and the right jacks for TRMT. When the switch is in the down position, connections are reversed. Connections are indicated by the RCV and TRMT annunciators. Connections can be made either to the 310 jacks, or to the T (tip) and R (ring) binding posts, which are multipled. The left jack field should always be used for 2-wire wet transmit and receive connections; the right jack field for 2-wire dry connections. Both left and right jack fields are used for 4-wire connections. The CHASSIS GROUND binding post can be used to establish a ground reference if an adequate ground cannot be established through the 310 jack sleeves or power line plug.



SETUP CONTROLS

NORMAL TEST – DIAL/TALK

In NORMAL TEST mode the selected TRMT jack is connected to the test set's transmitter circuitry, but not to the lineman's handset posts. In DIAL/TALK mode the TRMT jack is connected to the lineman's handset posts, but not to the transmitter circuitry.

TEST WITHOUT HOLD – TEST WITH HOLD

In TEST WITHOUT HOLD mode the test set holding circuit is disconnected from the RECEIVE/TRANSMIT JACKS. In TEST WITH HOLD mode the holding circuit is connected across tip and ring of the left jack field to hold 2-wire wet (DDD) circuits while testing.

TALK BATTERY ON – TALK BATTERY OFF

In TALK BATTERY ON mode the test set provides the necessary talk battery to the lineman's handset to talk on dry circuits. In TALK BATTERY OFF mode, talk battery must be supplied by the circuit under test if talking is desired.

TERM – BRIDGE RECEIVE

In TERM mode the test set provides a termination on both the RCV and TRMT circuits. The desired terminating impedance must be selected with the 600/900 key. In BRIDGE RECEIVE mode the receiving test set is bridged across the line under test, which is terminated with another device.

NOTE

When using the BRIDGE RECEIVE mode it is still necessary to select the impedance of the line under test with the 600/900 key in order to normalize the measurements.

600 – 900

The 600Ω or 900Ω mode must be selected to match the characteristic impedance of the line under test. When operating in the TERM mode, both the TRMT and RCV lines are terminated in the selected impedance. When operating in the BRIDGE RECEIVE mode, the TRMT line is terminated in the selected impedance and the RCV line is bridged by more than 50kΩ. The selection also normalizes level measurements for the respective impedances.

NO SF SKIP – SF SKIP

In NO SF SKIP mode the test set will transmit all selected frequencies. In SF SKIP mode the test set will not transmit any frequencies between 2450Hz and 2750Hz. This is to prevent the circuit under test from being disconnected by SF signaling units in the dial-up network.

NORMAL TEST – SELF CHECK

In NORMAL TEST mode the test set performs normal testing. In SELF CHECK mode proper operation of the test set can be verified by making measurements on its built-in self check circuitry.

HANDSET CONNECTED TO TRMT POSTS

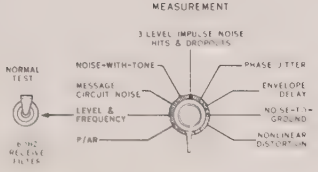
Two "cuff-link" posts provide the connection terminals for a lineman's handset (butt-in). The terminals are connected to the selected TRMT jack when the DIAL/TALK mode is selected.

DIGITAL DISPLAYS

Three digital displays provide measurement units and quantitative information for all measurements. Ranging is automatic, and polarity and decimal points are automatically displayed when appropriate. Up to three parameters can be displayed simultaneously. The displays also indicate underrange and overrange conditions. Display of only a (–) sign indicates underrange. Display of only a (+) sign indicates overrange.

DISPLAY CONNECTED TO KEY

The digital displays will present either the transmitted or received quantities when the DISPLAY CONNECTED TO key is thrown to TRMT or RCV, respectively.



MEASUREMENT SWITCH

The MEASUREMENT switch programs the test set to perform the selected measurement. The MEASUREMENT switch sets up indicator dot lamps, guiding the operator to other controls which need to be selected. Adjacent to the LEVEL & FREQUENCY position is the NORMAL TEST/60 HZ RECEIVE FILTER key. When the spring return key is held down in the 60 HZ RECEIVE FILTER position, a high pass filter attenuates 60 Hz power hum on the received signal. This filter reduces level measurement error caused by power line related noise. The filter is disconnected in the NORMAL TEST position.

NOTE

P/AR and NONLINEAR DISTORTION measurements are optional features and may not appear on some configurations of the test set.

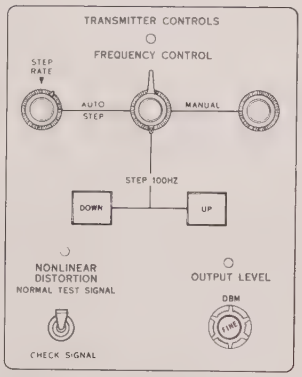
DESCRIPTIONS CONTINUED – LIFT PAGE

LINE MONITOR

The LINE MONITOR permits listening to the line under test, or the test set transmitter, on the built-in speaker or an external headset. The LINE MONITOR is normally connected to the receive line. To monitor the transmit line, press the PUSH TO MONITOR TRANSMIT OUTPUT push-button. When a plug is inserted in the 347 OUTPUT jack, the speaker is disconnected and the amplifier drives a headset or other device connected (must have an impedance of 150Ω or greater). An oscilloscope, spectrum analyzer, or other measuring device can also be connected to the LINE MONITOR OUTPUT for further analysis of the line under test. The output is an amplified reproduction of signals on the line (except in noise measurements, where the output amplitude is weighted by the selected NOISE FILTER).

TRANSMITTER CONTROLS

FREQUENCY CONTROL SWITCH



The FREQUENCY CONTROL switch is a three position rotary switch which selects the transmitter frequency control mode. In AUTO STEP mode the frequency is automatically stepped in 100Hz increments from 204Hz to 3904Hz at a rate controlled by the STEP RATE control. Frequencies are stepped repetitively up and down between the two limits, beginning at the point where the transmitter frequency is initially set. In STEP 100 HZ mode the frequency is manually stepped in 100Hz increments from 204Hz to 3904Hz by pressing the UP or DOWN push-buttons. (The STEP 100 HZ UP or DOWN push-buttons are also active in the AUTO STEP mode and can be used to override automatic stepping.) In MANUAL mode frequency is continuously variable over the range of 200Hz to 3904Hz by adjusting the MANUAL control.

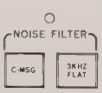
OUTPUT LEVEL CONTROL

The OUTPUT LEVEL control varies the output continuously over the range of −49dBm to +10dBm (to 0dBm for P/AR and NONLINEAR DISTORTION). Output level is adjusted while observing DBM on the right display.

NONLINEAR DISTORTION KEY

(This control is present only on test sets with the NONLINEAR DISTORTION option.) The NONLINEAR DISTORTION key permits comparison of a normal test signal and a check signal so that compensation for background noise can be made. When the key is in the NORMAL TEST SIGNAL position, two pairs of tones, centered at 860Hz and 1380Hz, are transmitted. When the spring return key is held in the CHECK SIGNAL position, power of the 860Hz tones is doubled and the 1380Hz tones are turned off.

NOISE FILTER PUSH-BUTTONS

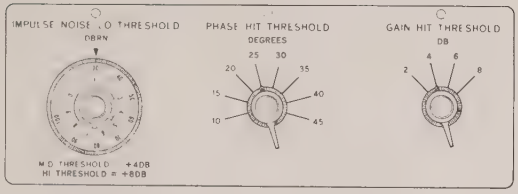


The NOISE FILTER push-buttons allow selection of either C-MSG or 3 KHZ FLAT noise weighting filters. Depressing a push-button activates the selected filter.

DISPLAY KEY

The DISPLAY key is used in conjunction with 3-LEVEL IMPULSE NOISE HITS & DROPOUTS measurements. When the key is thrown to IMPULSE NOISE position the displays will show COUNTS LO, COUNTS MID, and COUNTS HI. When the key is thrown to HITS & DROPOUTS position the displays will show PHASE HITS, DROPOUTS, and GAIN HITS. The three parameters not being exhibited are stored in the test set memory until they are recalled by the DISPLAY key. The key can also be operated while the measurements are in process to monitor a desired count accumulation.

IMPULSE NOISE LO THRESHOLD SELECTOR



The IMPULSE NOISE LO THRESHOLD selector is a two level concentric rotary switch which sets the desired lower "window" for impulse noise counts. The setting, in dBrn, is the total of the outer ring (tens) and the inner ring (units) alignment at the index mark. The test set will totalize as COUNTS LO, impulses whose peaks are above the selected threshold. The MID THRESHOLD is fixed at 4dB above the LO THRESHOLD setting. The test set will totalize as COUNTS MID, impulses whose peaks are above the MID THRESHOLD. The HI THRESHOLD is fixed at 8dB above the LO THRESHOLD setting. The test set will totalize as COUNTS HI, impulses whose peaks are above the HI THRESHOLD.

PHASE HIT THRESHOLD SWITCH

The PHASE HIT THRESHOLD switch selects the desired threshold for phase hit counts. The test set will totalize as PHASE HITS, rapid changes of phase that exceed the switch setting.

GAIN HIT THRESHOLD SWITCH

The GAIN HIT THRESHOLD switch selects the desired threshold for gain hit counts. The test set will totalize as GAIN HITS, rapid changes of gain that exceed the switch setting.

COUNT RATE PUSH-BUTTONS

The COUNT RATE push-buttons are used in conjunction with 3-LEVEL IMPULSE NOISE HITS & DROPOUTS measurements. When the BELL STD push-button is depressed the maximum rate at which counts can be totalized is limited to seven counts per second (per Bell Tariff). When the CHNL LTD push-button is depressed the maximum rate at which counts can be totalized is limited only by the channel bandwidth and the selected NOISE FILTER in the test set.

COUNT TIME PUSH-BUTTONS

The COUNT TIME push-buttons are used in conjunction with 3-LEVEL IMPULSE NOISE HITS & DROPOUTS measurements. When the 5 MIN push-button is depressed, the test set will totalize counts for 5 minutes from the time the START RESET push-button is pressed. Likewise, the 15 MIN push-button will provide a 15 minute counting interval. The IN PROCESS annunciator will light up during the counting interval and will extinguish when the interval is completed. When the NON-STOP push-button is depressed, the test set will totalize counts indefinitely from the time the START RESET push-button is pressed. The count time will cease and the displays reset to zero when another COUNT TIME push-button is depressed; when the START RESET push-button is pressed; when the MEASUREMENT switch is rotated; or when POWER is switched off.

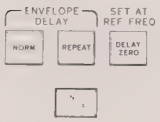
START RESET PUSH-BUTTON

The START RESET push-button is used in conjunction with 3-LEVEL IMPULSE NOISE HITS & DROPOUTS measurements. When pressed, the push-button clears the displays of their previous counts and initiates a new count period.

DESCRIPTIONS CONTINUED — LIFT PAGE

ENVELOPE DELAY PUSH-BUTTONS

The ENVELOPE DELAY NORM and REPEAT push-buttons determine whether the test set will be used to measure envelope delay (NORM) or to re-transmit the envelope delay signal from the far-end of the circuit (REPEAT).



DELAY ZERO PUSH-BUTTON

The DELAY ZERO push-button is used in conjunction with ENVELOPE DELAY measurements. When the normal test set is adjusted to the desired reference frequency, pressing the DELAY ZERO push-button will establish a zero microsecond delay reference. All subsequent envelope delay measurements are relative to this reference point.

NO LOOP ANNUNCIATOR

The NO LOOP annunciator will light up if the envelope delay loop is broken, or if the channel is attenuating either the transmit or receive signal to the extent that accurate readings cannot be made.

LEVEL ZERO PUSH-BUTTON

The LEVEL ZERO push-button is used in conjunction with LEVEL & FREQUENCY; and NONLINEAR DISTORTION measurements. When the test set is adjusted to the desired reference frequency, pressing the LEVEL ZERO push-button will establish a zero dB reference. All subsequent measurements will be made in dB relative to this reference point. If this push-button is not pressed, measurements will be in absolute dBm.

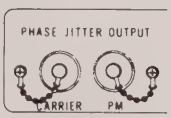
NOTE

If LEVEL ZERO push-button is pressed and it is desired to make an absolute dBm measurement, momentarily rotate the MEASUREMENT switch out of the selected mode, then back again.

NONLINEAR DISTORTION PUSH-BUTTONS

(These push-buttons are present only on test sets with the NONLINEAR DISTORTION option.) The SIGNAL LEVEL push-button allows measurement of the total received level of the nonlinear distortion test signal. Depressing the 2ND ORDER push-button allows measurement of only second order distortion products. Likewise, depressing the 3RD ORDER push-button allows measurement of only third order distortion products.

PHASE JITTER OUTPUT CONNECTORS



Two BNC connectors, located on top of the test set, provide means to further analyze phase distortion on the circuit. The CARRIER connector provides a square wave whose frequency is equal to the received carrier frequency in the PHASE JITTER measurement mode. The square wave signal does not contain any phase jitter components. The CARRIER output can be used to synchronize an oscilloscope or other device. The PM (Phase Modulation) connector provides an output proportional to the instantaneous phase deviation. This output can be analyzed on an oscilloscope, chart recorder, or other device to determine phase jitter characteristics.

SALES OFFICES

Arranged alphabetically by country

1

ANGOLA
Telectra
Empresa Técnica de Equipamentos Eléctricos, S.A.R.L.
R. Barbosa Rodrigues, 41-1°DT.°
Caixa Postal, 6487
Luanda
Tel: 35515/6

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Santa Fe 2035, Martinez
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Tel: 792-1239, 798-6086
Telex: 122443 AR CIGY

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AUSTRALIA

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Telex: 135066

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Bahrain
Tel: 54886, 56123
Telex: 8550 WAEL GJ

Al Hamidiya Trading and Contracting
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Manama
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